AN ANTHROPOLOGICAL STUDY OF AGRICULTURE AND HEALTH: A CASE STUDY OF PUNJAB

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Submitted By

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SUPERVISOR'S CERTIFICATE

This is to certify that the final report entitled **"An Anthropological Study of Agriculture and Health: A Case Study of Punjab"** embodies the work carried out by **Dr. Tejinder Kaur** herself under my supervision and that is worthy of consideration for the award of Post Doctorate Fellowship (PDF).

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DECLARATION

I, Dr. Tejinder Kaur, attest that the work included in this final report for my post-doctoral fellowship is authentic work that I completed at Punjab University's Anthropology Department in Chandigarh between July 2017 and August 2024, under the direction of Prof. A.K. Sinha. No other degree or diploma has been awarded based on the content of this Post Doctorate Fellowship final report. Additionally, I affirm that I have followed all guidelines for academic honesty and integrity and that, in my work, I have not created, misrepresented, or falsified any ideas, data, facts, or sources.

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This certifies that, to the best of my knowledge and belief, the candidate's aforementioned statement is accurate.

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LIST OF ABBREVIATIONS

AIDS	:	Acquired Immunodeficiency Virus
APP	:	Acute Pesticide Poisoning
CoV	:	Coronaviruses
EPA	:	Environmental Protection agency
HIV	:	Human Immunodeficiency Virus
IFOAM	:	The International Federation of Organic Agriculture Movements
IS	:	Indian Standards
PPCB	:	Punjab Pollution Control Board
WHO	:	World Health Organization

CHAPTER 1

INTRODUCTION

Concern over the world's growing demand for food and agricultural products has been exacerbated by overpopulation, the use of pesticides and fertilisers to increase crop yields and preserve plants, and the ensuing overexploitation of natural resources. According to Bergstrom and Randall (2016), this has caused an unexpected shift in attitudes and views of agriculture. The environmental impact of contamination and pollution has increased due to the implementation of innovative farming practices. There is a significant shift back towards the traditional farming methods that have been used for many years (Altieri, 2018).

1.1 Agriculture

Farmers utilize a broad variety of techniques including agricultural plants and domesticated animals. The main goal of agriculture is food production and as humans carry out the agricultural activities, there exists is a strong relationship between agriculture and anthropological studies. Anthropologists have studied agriculture, social life related to it and ancient and present cultural practices associated with agriculture. These studies have focused on a wide variety of subjects including biology, sociology, culture, history, language, cognition, materials, and technology. Archaeology, biology, language, and socio-cultural anthropology are the four main subfields that have studied agriculture from various standpoints (Sarker and Islam, 2017).

The Latin words ager, meaning "field," and agricultura, meaning "field work" or "tilling the ground," are the origin of the English word "agricultura." Furthermore, according to the Merriam-Webster Dictionary, it is the science, art, or practice of cultivating land, producing crops, rearing livestock, and, to varying degrees, processing and selling the final products (1828). The English Dictionary provides a more expansive definition of agriculture in 1971, stating that it is "the science and art of cultivating the ground, including allied activities such as gathering crops and rearing animals; tillage, agriculture, farming (in the broadest sense)".

In the late 1970s and early 1980s, while Robert (Bob) Rhoades (1942–2010) was a Rockefeller Postdoctoral Fellow at the International Potato Centre (CIP) in Lima, Peru, he coined the term "agricultural anthropology" to describe his work to his fellow social and biological scientists (Rhoades, 1984). According to Rhoades, agricultural anthropology is "the comparative, holistic, and chronological examination of the human component in agricultural practices, emphasising the interaction between environment, technology, and culture within both local and global food systems." Food and fibre production can be made more efficient and environmentally friendly with the use of this data. It is not just a techno-economic collaboration, according to agricultural anthropologists; rather, it is a complex human activity and evolutionary process including ideological, social, and cultural aspects in response to environmental problems. It encompasses greater ground than other, more niche areas of agriculture, as pointed out by Doddagoudra et al. (2017).

The agricultural surplus that may be sold is an important engine of economic development for emerging nations like India. In response to the rising need for food and other agricultural goods brought about by a rapidly expanding human population, the Green Revolution of the 1960s was the vehicle emersaged for bringing about food security. In response to long-term food shortages, nations like India were able to boost agricultural through the Green revolution, which was brought about by improved farming techniques, efficient machinery, and increased use of chemical fertilizers, weedicides and pesticides. The last grew to a large scale.

Agriculture has a crucial role to play in the survival and sustenance of population. In the developing world it is the backbone of the economy. Prolonged agricultural practices have caused problems with public health and the environment. Malnutrition, food poisoning, chronic and occupational diseases, and diseases affecting animals are some of the health problems associated with agriculture. Among the world's poorest people, the prevalence of malnutrition and food insecurity has grown as a direct result of the Western diet and way of life. Economic productivity has dropped and death rates have risen as a result of hunger and bad health caused by the decreasing intake of healthful meals on a worldwide scale. Domestic supply is low and prices are

comparatively high because of excessive food waste and substantial post-harvest losses.

Under the Agriculture Act of 1947, the term "agriculture" has been defined as "horticulture, fruit growing, seeds growing, dairy farming, and livestock breeding and keeping, the use of land as grazing land, meadow land, osier land, market gardens and nursery grounds, and the use of land for woodlands where that use is ancillary to the farming of land for agricultural purposes."

In fact, the most significant economic activity on the planet is agriculture as it employs the maximum number of people and provides them with the essentialities of food, clothes, housing, medicine, and leisure activities, all of which are fundamental to the establishment and growth of human civilizations. From 20,000 BC onward, there was a gradual global transition from nomadic hunter-gatherer tribes to more settled agricultural ones; this transition laid the groundwork for civilization. As a result of human energy needs, diversified natural ecologies are being supplanted by less complex systems that only support a small number of species (Hooker, 1993).

Meeting societal food and then guaranteeing a surplus for sale or other uses is agriculture's principal objective. Chemical fertilizers and insecticides are now indispensable for maximizing agricultural output and feeding the expanding human population. These methods have helped food grain production and sustainability, but they have resulted in adversely impacting upon the health and natural environment (Sharma and Shingvi, 2017).

1.2 Detrimental Impact of Chemical Agricultural Inputs

The use of pesticides and other chemical inputs has skyrocketed in recent years as a means to enhance agricultural output and productivity. Biological agents (such as viruses, bacteria, antimicrobials, or disinfectants) and chemical agents (such as pesticides) are used to eliminate pests. Their function is to reduce agricultural production by controlling pests that damage crops and animals prevent occurrence of weeds, and diseases in plants and to protect people from diseases transmitted by insects, flies, and other vectors. Pesticides are often used alongside pesticides,

fungicides, herbicides, rodenticides, and plant growth regulators are common examples (WHO, 1990; Alewu and Nosiri, 2011; NSW EPA, 2013). Major health concerns have been raised by the worldwide overuse of harmful pesticides in agriculture. The poisoning of crops and the environment has been caused by the recent developments in chemicals use in agriculture. Acute pesticide poisoning (APP) affects 3 million people every year, resulting in 20,000 accidental deaths; 99 percent of these deaths occur in underdeveloped nations, according to the World Health Organization (Dabady and Pierre, 2015).

Because they increase crop yield, pesticides have been useful for farmers all over the globe. Ecosystems have been disturbed by the deposition of pollutants through agricultural goods, soil, water, air, and upper echelons of the food chain. Following the Green Revolution, pesticide use rose.

Many of the pesticides used in agriculture are subject to restrictions because of the World Health Organization's (1990), Alewu and Nosiri's (2011), Hayes et al. (2006), and Zheng et al. (2016) findings that pesticides are hazardous to both humans and the environment. Although many of them are prohibited in industrialised nations, India and some other developing nations still utilise them. Pesticide exposure has different health impacts depending on the type of pesticide, exposure duration, contact technique, and underlying medical conditions (e.g., skin damage and nutritional deficiencies). Additionally, exposure can occur through skin contact or inhalation. Following ingestion, pesticides may experience metabolic alterations as well as functions such as excretion, storage, or bioaccumulation in adipose tissue (Pisaheb et al., 2015; Alewu and Nosiri, 2011; WHO, 1990). Among the numerous detrimental health effects associated with pesticides include issues with the skin, digestive system, neurological system, lungs, reproductive system, and endocrine system in both people and animals. According to Gunnell et al. (2007) and WHO (1990), excessive levels of occupational, unintentional, or intentional exposure can also lead to death or hospitalisation.

Excessive pesticide usage has been associated with an increase in chronic diseases in Punjab, according to many government reports and scientific research. According to

studies, farmers are at significant risk of coming into close contact with harmful substances. Many Indian farmers have worked in agriculture for many years, yet many still do not know how to handle pesticides safely, putting their health at risk. People in hotter places often say that they do not use protective gear because it is too uncomfortable (Jallow et al., 2017).

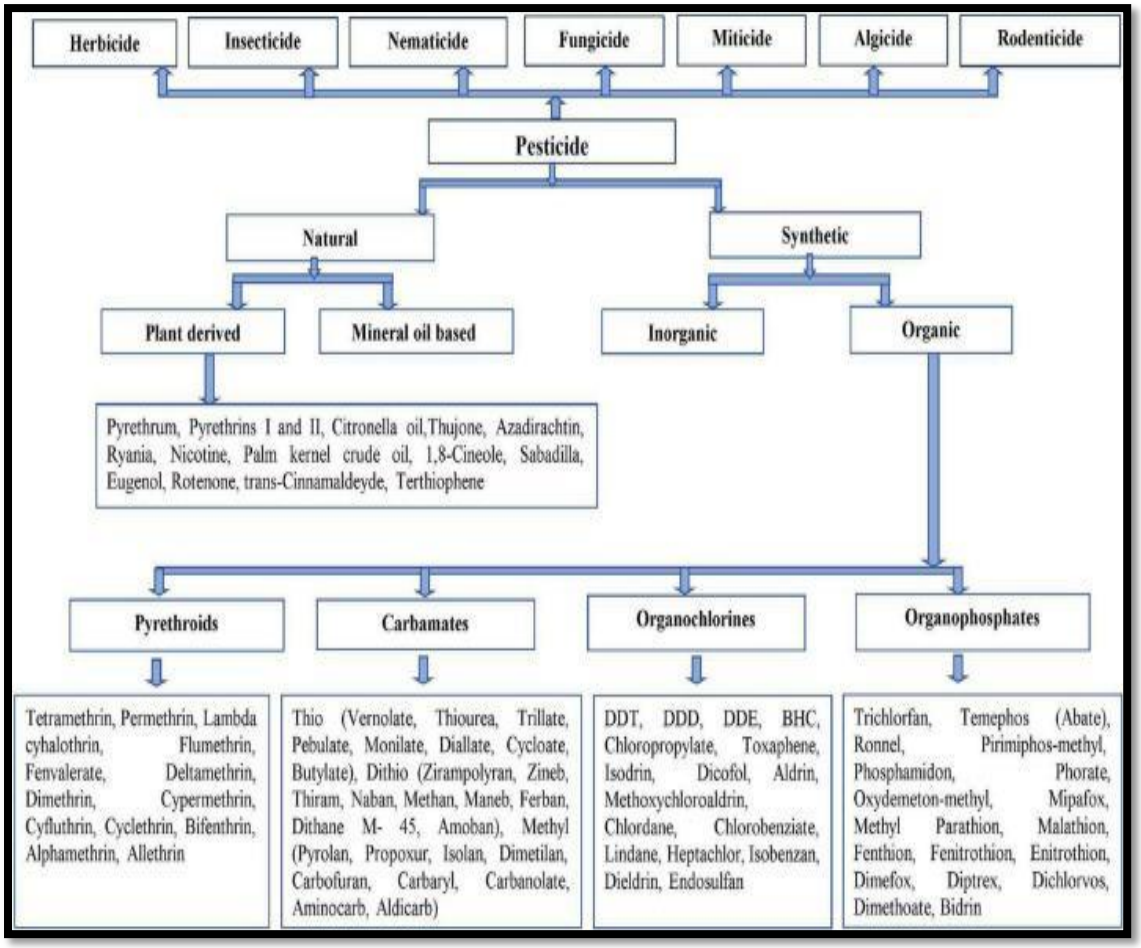
The environmental destiny of pesticides is greatly affected by the quality and efficacy of the soil and chemical properties, including how well they dissolve in water, how much they are adsorbed, how long they stay in the soil, and whether the soil is composed of clay, sand, or organic materials. The economic losses for farmers, inadequate pest management, and environmental damage are invariably caused by pesticides moving from their application locations to non-target regions (Dettweiler and Malakhov, 1977; Waite et al., 2002).

"Pesticide" covers a broad range of agricultural methods, including mixed crop-livestock farming, pastoralism, transhumance, vegeculture, horticulture, arboriculture, and domestication. Soil type, cultivation frequency, and main crops or animals are frequently the defining aspects of these techniques.

1.3 Categories of Pesticides

The chemical composition and quantity of pesticides used determine their toxicity, which is the basis for their classification. According to Garcia et al. (2012), the pesticide group includes antiseptics, disinfectants, anti-bacterial, fungicides, algicides, rodenticides, and herbicides. Pesticides can be divided into two types based on their chemical and physical characteristics. When classifying pesticides, consideration is given to both their synthetic or natural origin and how well they work against particular pests. As subsets of the chemical molecules that comprise the great majority of synthetic pesticides, they are divided into organophosphates, organochlorines, carbamates, and pyrethroids (Figure 1). Because biopesticides are derived from living things, Abubakar et al. (2020) and Bhatt et al. (2020a, 2021b) both claim that they are a type of natural pesticide.

Figure 1: Categorization of Pesticide


Herbicide
Insecticide
Nematicide
Fungicide
Miticide
Algicide
Rodenticide
Pesticide
Natural
Synthetic
Plant derived
Mineral oil based
Inorganic
Organic
Pyrethrum, Pyrethrins I and II, Citronella oil,Thujone, Azadirachtin, Ryania, Nicotine, Palm kernel crude oil, 1,8-Cineole, Sabadilla, Eugenol, Rotenone, trans-Cinnamaldeyde, Terthiophene
Pyrethroids
Carbamates
Organochlorines
Organophosphates
Tetramethrin, Permethrin, Lambda cyhalothrin, Flumethrin, Fenvalerate, Deltamethrin, Dimethrin, Cypermethrin, Cyfluthrin, Cyclethrin, Bifenthrin, Alphamethrin, Allethrin
Thio (Vernolate, Thiourea, Trillate, Pebulate, Monilate, Diallate, Cycloate, Butylate), Dithio (Zirampolyran, Zineb, Thiram, Naban, Methan, Maneb, Ferban, Dithane M- 45, Amoban), Methyl (Pyrolan, Propoxur, Isolan, Dimetilan, Carbofuran, Carbaryl, Carbanolate, Aminocarb, Aldicarb)
DDT, DDD, DDE, BHC, Chloropropylate, Toxaphene, Isodrin, Dicofol, Aldrin, Methoxychloroaldrin, Chlordane, Chlorobenziate, Lindane, Heptachlor, Isobenzan, Dieldrin, Endosulfan
Trichlorfan, Temephos (Abate), Ronnel, Pirimiphos-methyl, Phosphamidon, Phorate, Oxydemeton-methyl, Mipafox, Methyl Parathion, Malathion, Fenthion, Fenitrothion, Enitrothion, Dimefox, Diptrex, Dichlorvos, Dimethoate, Bidrin

Source: Classification of pesticides (Jayaraj et al., 2016; Hassaan and El Nemr, 2020; Malhotra et al., 2021; Souto et al., 2021; Parra-Arroyo et al., 2022).

The deadly consequences of pesticide use that last for a long time are referred to as chronic poisoning. The long-term effects of pesticide poisoning are especially dangerous for farmers and agriculturalists because of their continuous exposure. Upon application to a particular plant or area, pesticides eradicate indigenous microorganism species and other physiochemical components. Their effects on plants and animals vary depending on the environment in which they are introduced; this was not a consideration when the pesticides were used (Tudi et al., 2021).

When pesticides enter an ecosystem, they interact with several elements, including light, heat, moisture, oxygen, and bacteria, which cause them to physically and microbiologically degrade. The end result of this mechanism is metabolites. Because of their unique chemical composition, these metabolites can have both positive and

negative effects (Marie et al., 2017; Liu et al., 2015). Adsorption, leaching, volatilisation, and surface runoff are some of the ways in which pesticides and their metabolites can move from their original sites of application to unintended locations, where they can cause long-term pollution and even damage. Citation: Tudi et al., (2021). The organic matter and texture of soil have an effect on water, soil, and the ecosystem, according to research by Qin et al. (2014).

Detrimental chemical load on natural ecosystems has grown astronomically as a result of agricultural industrialization leading to extreme negative impact on human and environmental health, pesticides have been observed and studied to pose a major threat to the immediate agricultural environment, public health, urban green areas, and operational agricultural practices.

The Green Revolution on the one hand, accelerated rapid development in farming practices which led to a dramatic rise in agricultural output. Three fundamental ideas formed the basis of the revolution:

(i) The need to feed the people,

(ii) The scarcity of arable land,

(iii) The dependence on fertilizers and other external inputs to increase harvest yields (challinor et al., 2014).

Producing food is critical to human sustenance making it an important function of agriculture. The environment, cultural behaviors, and technological improvements mediate the links between agriculture, food, and health. Optimal nutrition via sustainable food production takes into account the interaction of agriculture, the environment, culture and technology is the problem of today.

Soil quality and functioning have been adversely damaged by the use of agrochemicals such nitrogenous fertilizers and pesticides, even if grain output has grown (Saikia and Nath, 2017; Singh, 2000). Additionally, there are a number of ecological and socio-economic issues that have resulted from the maximization of agriculture's and its allied activities on which is currently dependant food insecurity,

loss of stability and efficiency, farmer indebtedness, agricultural abandonment, and urbanization (Altieri, 2018). Farming is successfully fighting poverty, but contemporary observations show that it poses severe health comparisons like hunger, malaria, food poisoning, besides work-related injuries and diseases. Farming offers vital resources and livelihoods, good health and productive agriculture ensuring that health emanates from the farm and is in turn dependant on the health of the farmer.

Pesticides tend to contaminate ground water, rivers and air, which have long-term consequences that are a major concern for scientists, farmers, and environmentalists are all too familiar with. Because of factors like as drift during application, vapor loss after application, and wind erosion of treated soil, have shown that pesticides have the potential to pollute the air. Surface runoff from treated areas, both wet and dry air deposition of pesticides, and nearby vegetation can contaminate the soil, vegetation, and water bodies around the fields (Cessna et al., 2005).

Pollution from agricultural activities has a substantial influence on rivers, which are vital for transporting water and nutrients. To determine how industrial heavy metal contamination affects the health of riverside inhabitants, this research used the Ghaggar River. Himachal Pradesh and Haryana's Siwalik Hills which are the headwaters of the Ghaggar River. Villages around the river have seen groundwater pollution due to agricultural and industrial operations. Worldwide, water issue has been known to have worsened by both natural and environmental changes besides human activities, which have further diminished the water quality (Adimalla and Quian, 2021; Ahamad et al., 2018). Staffing, technological backwardness and budgetary limitations make it difficult for many of the smaller water systems to monitor and maintain water quality. Criteria for microbiological infections, nutrient contamination, and pesticides are all part of the agricultural water pollution standards.

1.4 Leaching Impact of Pesticides

Pesticides may seep downhill via soil pores and fissures, a process known as leaching. Soil filtration allows water to wash away pollutants like pesticides. Several factors impact the process of leaching, while altering the characteristics of the soil (such as

organic matter content, texture, and acidity), the characteristics of the pesticide (such as solubility, adsorption, and persistence), the methods of application, and the weather. According to Toth and Buhler (2009), groundwater may be polluted by pesticides that seep into the soil.

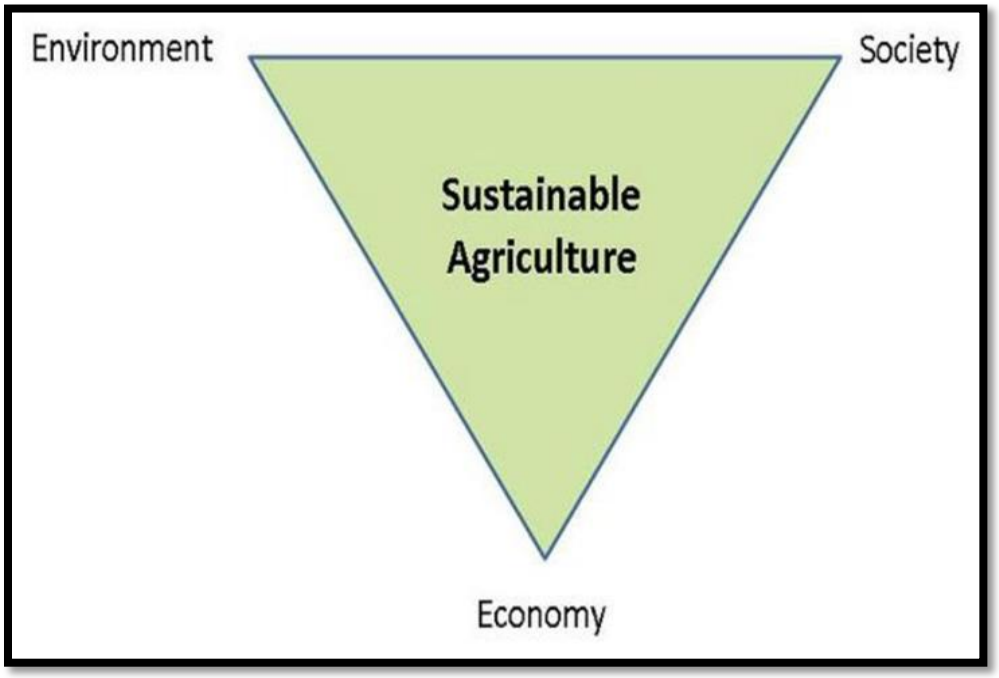
Agriculture has contributed majority to the use of agrochemicals, which have contaminated the environment to a considerable degree. If these chemicals are used unchecked, they can make the water, air, and farmland unfit for human habitation. Pollution in rural areas typically goes unchecked since most government environmental protection efforts target cities. Agricultural practices are responsible for polluting water supplies to the tune of 50–70% (Lal and Stewart, 1994).

Increased food production and increased public health concerns are two facets of agricultural science today. Fungal contamination of crops, leading to the creation of mycotoxins, can cause epidemics among humans. The problem seems to have worsened due to insufficient post-harvest technologies and untimely rains during harvests. There is a long history of linking naturally existing contaminants in foods—whether eaten alone or combined with grains—to the spread of illness. Pesticides and antibiotics are examples of agrochemicals used in veterinary medicine and aquaculture, which pose additional health risks.

The Food Born Disease Complex

The introduction of food-borne diseases via conventional and organic farming methods is a concern for public health. Without adequate regulation, modern biotechnology—and GM foods in particular various health concerns have arisen. To decrease the chances of harm to people's health caused by unsanitary farming methods, food safety systems like Hazard Analysis and Critical Control Points (HACCP) have been promoted on a worldwide scale (Bhat, 2008).

Figure 2: Sustainable agriculture gives equal weight to environmental, social, and economic concerns.



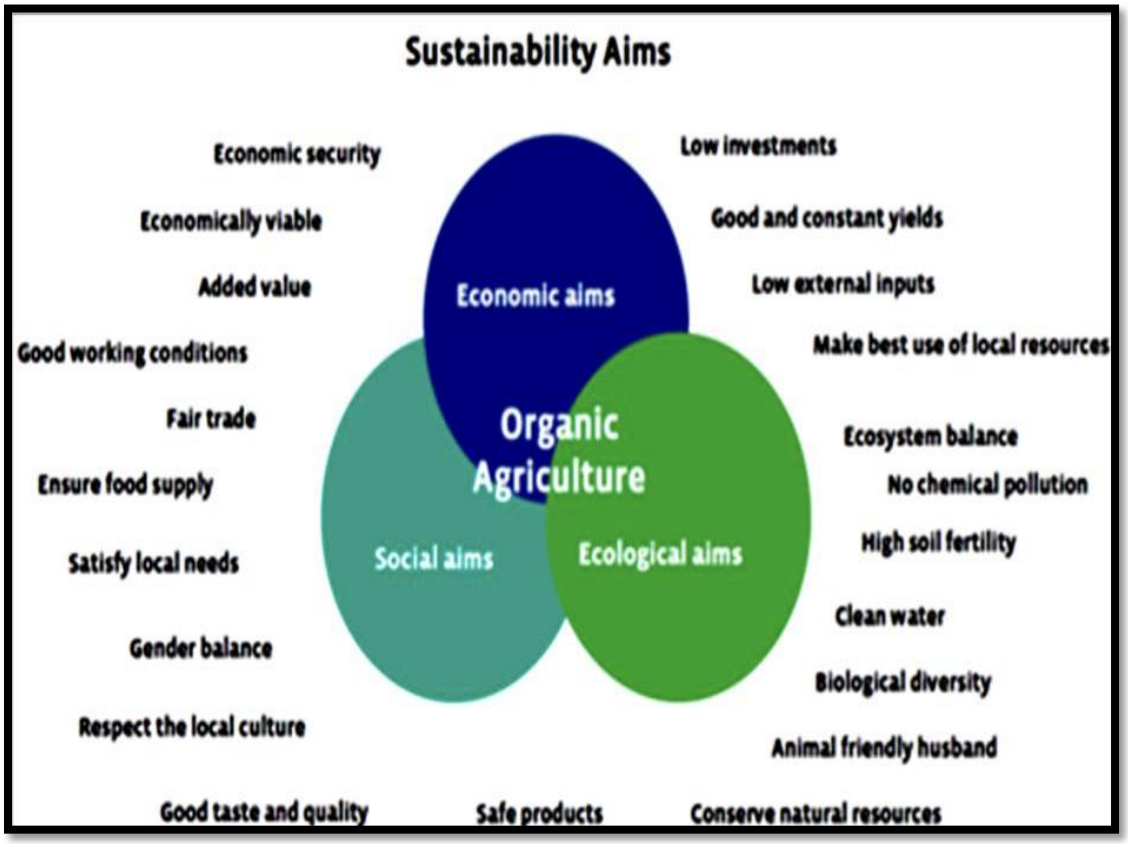
Source: *Journal of Sociology and Anthropology*. 2017, 1(1), 47-52

Figure 2 shows that sustainable agriculture aims to achieve three main goals: economic profitability, social equality, and environmental health. While different ideologies, regulations, and methods help accomplish these objectives, there are certain guiding concepts that are included in the majority of sustainable agricultural definitions. More and more people in the food production sector are encouraging the sustainable agriculture movement popular across the world.

1.5: Organic farming

A variety of agricultural techniques contribute to environmental sustainability, and organic agriculture is only one of them. Most emerging economies today have agriculture as an important engine of economic development. There is growing concern for preserving valuable natural resources, eliminating poverty, and assuring food security. According to Rothschild (1998), the Green Revolution implemented in over 90 percent of the developing countries, in Asia but there is a wave of urbanization impacting upon the agricultural landholding and their use.

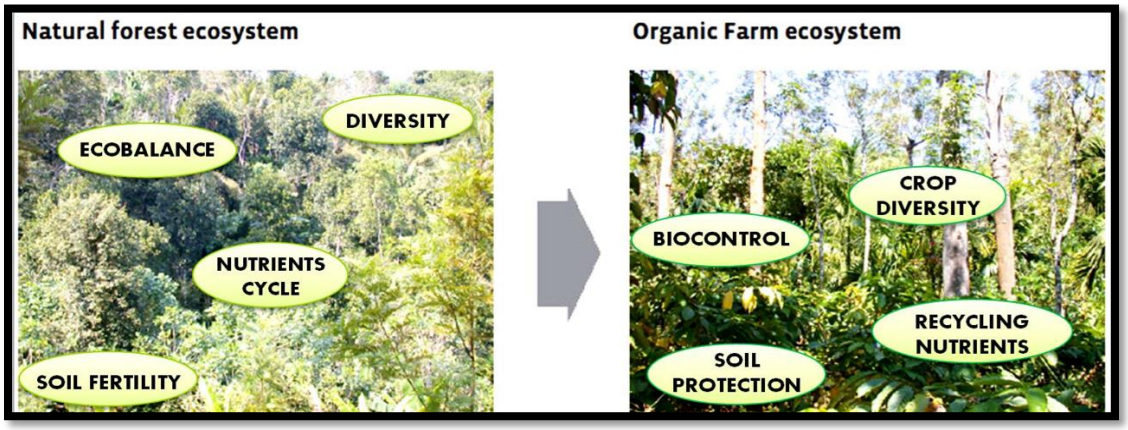
Figure 3: The Three Dimensions of Sustainability



For an agricultural system to be deemed sustainable, all three of the criteria shown in Figure 3 must be met. To decrease their negative effects on the environment, organic farmers use a holistic production approach that does not include genetically modified organisms, synthetic fertilizers, or pesticides. Organic farming occupies a small fraction of farmland in most countries including India (0.03%) in Asia and Austria (11.3%) in Europe. To improve soil health and boost crop output, organic farmers utilize microbial fertilizers and other organic materials, which is good for the environment and natural resources.

With organic farming it is the soil, the plants, the animals, the insects, the farmer, and the environment that have to work together in harmony, much like the many organs and appendages of a human body. By modeling the efforts after natural ecosystems and using agronomic, biological, and mechanical concepts wherever feasible, this goal can be achieved (Figure 3).

Figure 4: Using Natural Ecosystem as A Model



(Source: Training manual for organic agriculture, 2015)

To promote organic farming on a global scale, the non-governmental organization known as the International Federation of Organic Agriculture Movements (IFOAM) laid forth the following principles in 2003:

(i) Every step of the organic food chain—from planting seeds to eating the finished product—must contribute to the well-being of all living things, from the tiniest soil microbes to the largest consumers on Earth. It needs to stay away from potentially harmful fertilizers, pesticides, animal medications, and food additives.

(ii) Ecology Principle: Organic farming practices should align with and contribute to the maintenance of natural ecosystems and their cycles. It has to be scaled, localized, ecologically appropriate, and culturally appropriate. We can improve environmental quality and save resources by reducing inputs via recycling, reusing, and efficient energy and material management.

(iii) This approach ensures that all stakeholders involved in organic agriculture—farmers, laborers, processors, distributors, merchants, and consumers—are treated fairly. Furthermore, it stresses the need for treating animals in a way that is consistent with their inherent habits and health. Management of production and consumption-related natural and environmental resources should be equitable and sustainable, with a focus on maintaining these assets for the benefit of future generations. To be fair, production, distribution, and trading systems must be open, egalitarian, and take actual social and environmental costs into consideration.

(iv) Care Principle: Organic farming's management, development, and technological choices are based on a commitment to responsibility and prudence. Organic farming must adhere to strict scientific guidelines to guarantee it is safe for consumers and the environment. On the other hand, it has to take into account real-world examples, traditional wisdom, and indigenous knowledge in order to steer clear of dangers and embrace safe technology while avoiding risks like genetic engineering.

Organic farming has recently become quite popular. Examining the fundamental ideas, difficulties encountered by farmers, and techniques involved in organic farming, as well as their level of awareness and progress, this research looks at the impact of rural India. While discussing current developments in organic farming, it examines the importance of organic farming in India and the advantages it offers in terms of food security and yield potential.

Agriculture has been India's main source of income for a long time. More than 60% of the population relies on agriculture and related industries for their livelihood. In the 1960s, the Green Revolution was necessary due to a number of problems, including low productivity, food shortages, and increasing food imports. Even while crop yields increased, problems such as land degradation, reliance on foreign inputs, and inequities among farms and areas emerged as a result of the state-sponsored, quick push for synthetic inputs and hybrid varieties (Evenson and Gollin, 2003; Sanyal 1983; Freebairn 1995). Produced less than other countries, India's agricultural output has been steadily increasing in recent years (Mahadevan 2003).

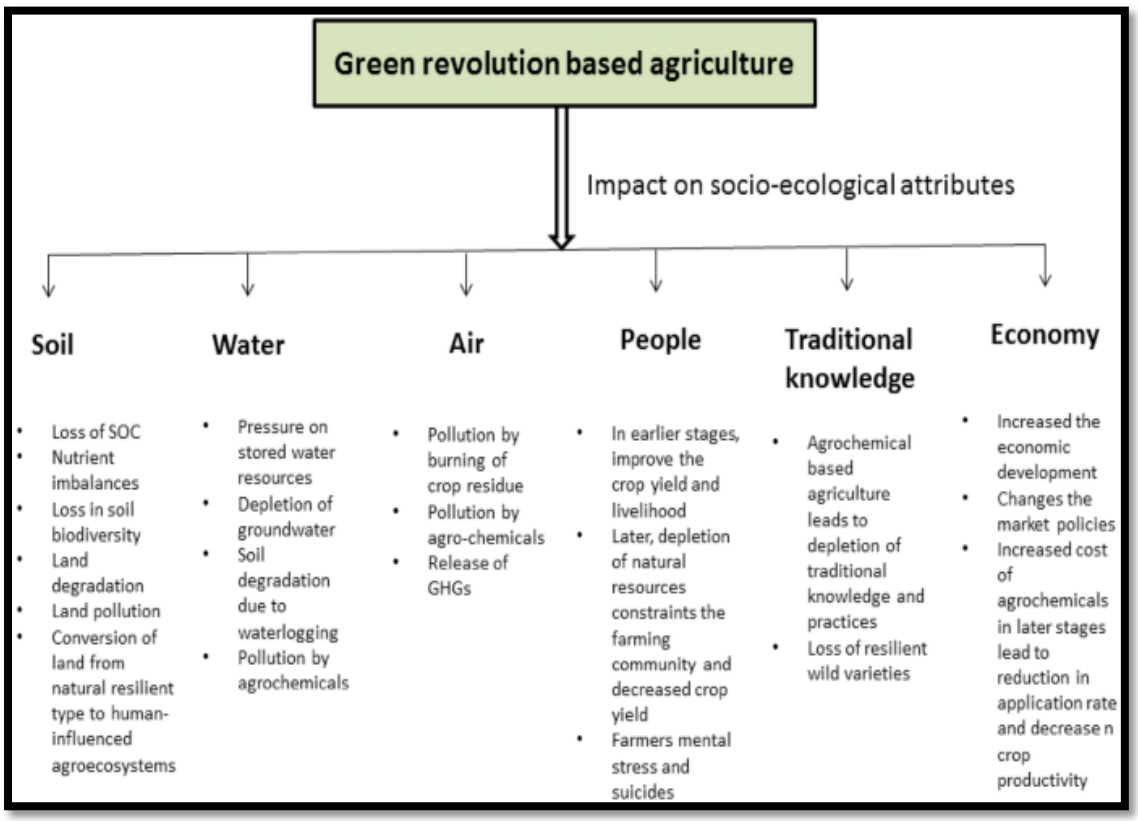
Conway (1997) and Dalrymple (1979) state that the term "Green Revolution" was initially used in 1968 by William S. Gaud of USAID to describe the new policies and technologies that developed nations assisted developing nations in implementing from the 1940s to the 1960s in order to increase food production. During this period, organisations such as the International Rice Research Institute (IRRI) in the Philippines and the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico created genetically modified seeds. HYVs, or high-yielding varieties, were also released to the public. Thanks to a combination of genes and features that cause plants to grow shorter, researchers have discovered that yield has increased.

When India gained Independence in 1947, almost half the country's population was subsistence farmers. Most farmers, however, stuck to old ways of farming even as

technology advanced, this went on for generations (Lockwood et al., 1971). A combination of animal and human labor propelled the cultivation of genetically modified seeds in fields that had previously relied on wooden plows, waterwheels, and bullock carts. The agricultural sector in India collapsed during this time, which had a knock-on effect on industry. Droughts and severe famines were more common in the mid-1960s, when land reforms and technological innovation were lacking. Reducing India's domestic grain output, huge imports of subsidized food grains (wheat) from the USA relieved the situation. In response, interested parties and donor organizations began to alter farming methods in an effort to increase grain output while simultaneously reducing depletion of reserves.

With the development of high-yielding wheat and rice cultivars, the "Green Revolution" gained traction in India as a means to increase food production and fight poverty and famine. Although the output of wheat and rice was increased by 100% as a result of this program, the output of millets and some indigenous rice types was greatly reduced. As a result, many of the indigenously unique native crops were on the verge of extinction.

Figure 5: Green revolution based agriculture


Green revolution based agriculture
Impact on socio-ecological attributes
Soil
Loss of SOC
Nutrient imbalances
Loss in soil biodiversity
Land degradation
Land pollution
Conversion of land from natural resilient type to human-influenced agroecosystems
Water
Pressure on stored water resources
Depletion of groundwater
Soil degradation due to waterlogging
Pollution by agrochemicals
Air
Pollution by burning of crop residue
Pollution by agro-chemicals
Release of GHGs
People
In earlier stages, improve the crop yield and livelihood
Later, depletion of natural resources constraints the farming community and decreased crop yield
Farmers mental stress and suicides
Traditional knowledge
Agrochemical based agriculture leads to depletion of traditional knowledge and practices
Loss of resilient wild varieties
Economy
Increased the economic development
Changes the market policies
Increased cost of agrochemicals in later stages lead to reduction in application rate and decrease n crop productivity

Consolidation of holdings is made possible when small farmers relocate to metropolitan areas and sell or lease out their agricultural property, a practice known as contract farming (Joshi and Gulati, 2003). A vast population relies on the agricultural industry for their livelihood and cultural possibilities, yet this perspective disregards both. Research shows that urban poverty and inequality are on the rise, because of the probable presumption that farmers would find profitable employment in cities (Sen and Himanshu 2004). Due to better resource utilisation, small Indian farms outperform bigger farms in terms of production (per acre) and have a lower fertiliser imbalance index (Chand et al. 2011). According to Lutz (1998), small farmers are generally reasonable and adapt to new situations by considering the possibilities and limitations they confront. Despite this, farmer suicides and suffering have been on the rise (Rao and Gopalappa 2004; Vasavi 2009). Supporting and sustaining small-holder farming in India which is still a contentious issue, especially among academics, despite the apparent necessity to do so.

The contamination of agricultural land and food may occur as a result of nuclear or radioactive incidents. Agricultural land and products may include contaminants, which are things that were not purposefully introduced to them. They may come from the environment or be caused by people, and they can include radioactive or stable elements.

Figure 5 defines some of the Agricultural Systems. This is an effort to differentiate between many frequently used phrases related to agricultural systems and their subsequent transformations. (According to the 2003 report of the International Federation of Organic Agriculture Movements) impact of COVID-19 Pandemic on Farming in and Around S.A.S. Nagar, Punjab.

Coronaviruses (CoV) are a big family of viruses that may cause everything from a mild cold to serious respiratory illnesses like MERS-CoV and SARS-CoV, according to the World Health Organization (2020). When a new kind of coronavirus is found in people, it is called a novel coronavirus (nCoV). A recently identified coronavirus caused an infectious condition known as coronavirus disease (COVID-19). A mild to severe respiratory disease characterized by a lack of response to standard therapy is the hallmark of a COVID-19 infection. Serious sickness is more common in the

elderly and in persons with pre-existing conditions such as cancer, diabetes, chronic obstructive pulmonary disease, or each cardiovascular disease.

Anthropology investigates the variety and diversity by beginning with certain commonalities. These fields share a commitment to a multi-faceted understanding of human biology and social variation by examining at it from a historical, cultural, and environmental[1] perspective An Introduction to Anthropology (2016).

The role of social scientists, and anthropologists in particular, in responding to disease outbreaks has recently come to light. This study aims to bridge the gap between disciplinary expectations in emergency situations by providing a foundational overview of anthropological approaches. By providing a foundational overview of anthropological methodology and thinking, this study demonstrates how anthropologists may use their discipline to address public health crises, such as the COVID-19 pandemic. It offers a brief overview of anthropology's history and present contributions to public health concerns and speculates on the field's potential future functions.

Around half of India's workforce was in agriculture and its various allied fields which was negatively impacted by the shutdown. According to Schmidthuber and Pound (2020), several farmers were unable to sell their winter harvests because of a shortage of personnel and disruptions in supply networks. In India the summer Harvest stood in the fields because of similar reasons.

The entire food chain was impacted by the COVID-19 epidemic. Both global and national food systems have been threatened by this equilibrium-breaking, asynchronous shock. Although it had distinct impacts at various times, it shifted routes of supply and demand. All stages of the food supply chain were impacted, including production, processing, commerce, logistics (both domestic and international), and consumption. Factor markets, including those for labor and capital, as well as intermediate inputs to manufacturing, were also impacted. Various macroeconomic variables, such as fluctuations in the value of the currency, changes in the energy and credit markets, and most significantly, the anticipated increase in the unemployment rate and decreases in total economic activity, are likely to have an impact on food and agricultural demand.

[1] (American Anthropological Association: Advancing Knowledge, Solving Human Problems)

Around the nation, farmers are facing a number of challenges as a result of the COVID-19 pandemic. The COVID-19 pandemic lockdown has affected every part of the Indian economy. Agriculture, with its many distinct parts that make up the agricultural value chain, was profoundly affected by this epidemic. When it came time to harvest, the biggest issue plaguing the agricultural industry was the lack of migrant workers. Supply chain interruptions also occur as a result of transportation which had also been completely shut down.

According to the Indian Council of Agricultural Research, (2020) some of the Agricultural and allied activities exempted from the imposing of total lockdown were:

(i) Animal clinics

(ii) Organizations involved in acquiring agricultural goods, including those involved in MSP operations

(iii) "Mandis" run by the Agriculture Produce Market Committee or as announced by the State Government

(iv) Field operations involving farmers and farm laborers

(v) Custom Hiring Centers (CHC) pertaining to agricultural machinery

(vi) Facilities for Pesticide, Seed, and Fertilizer Production and Packaging

(vii) Transit within and between states of machinery used in planting and harvesting, such as combination harvesters and other agricultural and horticultural tools

1.6 Harvesting and Threshing of Crops During Pandemic

Even though the spread of COVID-19 was a concern, the rabi crops were getting close to maturity. The time-bound nature of agricultural operations makes harvesting, processing, and transporting goods to markets an unavoidable part of the industry. However, in order to stop the spread of the illness, farmers had to adhere to certain safety protocols. Social distance, regular hand-washing with soap, wearing a face mask, protective gear, and cleaning tools and equipment are all simple precautions to take. Workers are expected to adhere to safety protocols and maintain social distance throughout the total field operations procedure.

Harvester combines were ready to harvest wheat in a number of northern States, and the movement of these machines both within and between states is legal. Workers involved in repair, maintenance, and harvesting operations must take all necessary precautions to protect their safety.

The second most significant rabi crop is mustard. Harvesting was being done by hand, and threshing has to be done wherever harvesting has already been completed. Lentils, maize, and chilies were harvested, and gram followed the agricultural cycle. In the States of the North, sugarcane harvesting and hand planting were both at their height around the peak of the pandemic.

During, and after harvesting any of the field crops, fruits, vegetables, eggs, or fish, all those involved in the activity had to adhere to certain standards of personal cleanliness and social distance.

1.7 Consequences Faced by Farmers due to Lockdown:

Millions of farmers in India suffered severe losses because there were not enough workers, trucks were not available and the demand was not high enough to cover the production costs during the lockdown. As a result, the harvest of rice was lost and the wheat was only party harvested and salvaged.

It was the same story in almost every State. For instance, in the neighboring State of Haryana—a region known for its bountiful farming the lockdown caused major businesses, restaurants, and hotels to seal their doors, resulting in a complete lack of customers. Concerns about the spread of disease due to the handling of vegetables by too many individuals caused a precipitous decline in demand from households."

In the Punjab region, where this research was conducted, '*aarthias'* or moneylenders work in mandis to provide lakhs workers for the wheat procurement process. During the lockdown there was no way for the workers to return to Punjab at any point after they had left for their respective States. Lockdown restrictions impacted severely on the vegetable producers in Punjab particularly those who cultivate strawberries, bell peppers, cucumbers, and cabbage all of which were highly perishable. The farmers were having a hard time making ends meet, and there were shuttered marriage palaces, restaurants, dhabas, and stores. In addition, farmers complained that the situation had been exacerbated by a lack of government assistance, strict regulations,

a lack of labor, an unpredictable power supply, and a delay in the removal of crops from mandis.

There is a current push to have farmers utilize combine harvesters for everything. Balbir Singh Rajewal, president of the Bharatiya Kisan Union—Rajewal, stated that this is due to the fact that farmers typically use combine harvesters through village cooperative societies, which reduces the need for labor. However, this time around, the farmers will be required to handle harvesting independently.

"One of the farmers noted that the procedure is so streamlined that it is carried immediately to the mandis after harvesting the crop, rather than being stored at home, as was the case in the past when farmers in Haryana and Punjab, like most other states in India, used to storegrain at home before taking to the grain market or 'mandi'. Another farmer has said, "This is not a feasible approach." In response, Shiromani Akali Dal President Sukhbir Singh Badal has asked the Punjab government to provide gunny sacks to farmers so they may keep the wheat on their property. To start, there is just is not enough room to keep all that wheat. The wheat will begin to decay or become insect-infested within two months.

1.8 Immediate Challenges faced by the farmers

The crops from the farms could not make it to the 'mandis', or grain markets, during the lockdown period and certain government agencies were constrained to purchase them at subsidized rates. Wheat, gram, lentil, mustard, and other crops (including paddy in irrigated areas) are either in harvestable stage or nearing maturity during the shutdown period in India, which is also the height of the rabi season. The total Government apparatus faced its greatest test during the lockdown while ensuring that citizens in rural and urban regions could have access to basic staples including grains, fruits, and vegetables. During the lockdown, the organized industry participants' uptake was hindered by a lack of manpower and transportation problems, which slowed down the sale of dairy goods, fish, poultry, etc as well.

During the lockdown period the farmers were granted an exemption. Farmers, farmhands, and any machinery used for planting or harvesting would not be subjected to the lockdown, according to a notice from the Union Home Ministry. The rabi harvesting season happened to fall during lockdown, therefore farmers across were

counting on the government to ensure that their crops can be harvested without interruption and that procurement runs smoothly.

However, a positive development was the Union Home Ministry's circular for removing limitations on the movement of farmers, workers, harvesting equipment, and associated agricultural machinery within and between States. Government mechanisms must emphasize the safety and wellbeing of workers, while also assuring their availability for vital agricultural activities, to prevent any COVID infections.

CHAPTER 2
LITERATURE REVIEW

Soil, according to Oliver (1997), can influence human health directly and indirectly in several ways, resulting in illnesses and poor health overall. Ingesting pollutants through soil may cause cancer if it includes asbestosiform materials. Ingesting infected soil can induce gastroenteritis (geophagia). Soil particles can enter the body via cuts and scrapes lead to health conditions like elephantiasis; tetanus and hookworm infestations besides several other possible outcomes of soil-borne diseases. Insufficient or harmful amounts of components in food or water are the usual culprits when it comes to soil-related illnesses. It is possible that the amounts of elements such as zinc, lead, selenium, thallium, copper, fluorine, iodine, and arsenic indicate either the soil's natural State or the consequences of human activities, including pollution. Distinct relationships between trace elements and the aetiology of illnesses may be discovered in isolated subsistence societies that cultivate their own food. Diseases like *itai-itai,* brought on by an excess of cadmium, and *Keshan,* caused by a lack of selenium, are two examples. Additional research is needed to confirm some of the relationships between soil and health, since their reasons are hypothesized.

Chhonkar P.K.'s 2000 book, The Indian Experience with Industrial Effluents on Soil Health and Agriculture (Part - 1), covered the topic of distillery and paper mill effluents in particular. The distillery and paper industries in India are densely concentrated along rivers that are drenched in industrial effluents. The water contains large amounts of nitrogen, phosphate, potassium, calcium, and sulphur. Industrial effluents have high concentrations of biological oxygen demand (BOD) and chemical composition (COD), and they contain a broad range of organic and inorganic components depending on their production location. The utilisation of effluent in farming is an economical choice. The efficacy of various waste streams as irrigation sources must be carefully considered in this context. With the present energy and nutrition crises, not to mention the newly acknowledged need for water conservation, the economic value of these fluids is certain to remain high. Paper mill effluents can harm some crops when sprayed over soil, but they can help others when administered in diluted form, according to research. This is especially true for seed germination and seedling development. The disposal of these effluents in rivers leads to several

problems, such as a rise in organic load, a decrease in oxygen content, and the extinction of aquatic species in the water course. Control and treatment strategies are required for these effluents. The article delves into the topic of agricultural effluents, including topics such as their manurial potential, methodologies, and constraints.

A workshop sponsored by the Sasakawa Africa Association was held in Accra and Cape Coast, Ghana, and was reported in Maguire's (2000) World Bank report titles, 'Agricultural Education in Africa: Managing Change, Rural Development Department'. Participants at the conference learnt about current trends in agriculture education. More significantly, they look away the inspiration and commitment to do something constructive about the challenge of change by discussing a better grasp of issues, basics, and explanations. The article discusses the global prosperity of farming. The production of food has never been greater, despite severe weather, natural disasters (such as droughts) that impact areas of the Americas, Africa, and Australia, as well as floods, storms, insect attacks, and a rapidly increasing human population. The danger of widespread famine that Malthus (1766–1834) has foretold had likewise been vanquished by humans. The results of the work researchers, educators, and extension agents brought crucial technical discoveries to the farmers, and consequently resounding success. However, educational institutions are under continual pressure to adapt to the new realities of change. The contexts in which agricultural education operates are changing fast as are many other parts of development. It may be confusing but it has several prospects and potentials (Oniango and Eicher, 1999).

2.1 Use of Pesticides in Deliberate Human Harm Causation

In order to assess the frequency and seriousness of various types of self-harm, Chowdhury et al. (2007) examined records of deliberate self-poisoning in adults from 13 sundarban Blocks' Block Primary Health Centres. This study examined the impact of pesticide poisoning in suicide and nonfatal deliberate self-harm among farmer households in India's Sundarban region with the aim of clarifying hazards, safe practices for pesticide storage and usage, and related self-injury (intentional and unintentional). Due to the serious health risks to farmers posed by this type of slow pesticide absorption, the problem is especially common in low- and middle-income countries. Reducing the number of farmers who commit suicide should be the aim of

public mental health programs. To investigate farmer families' attitudes and practices around pesticides, a community study was carried out. The study concentrated on pesticide use, storage, and health impacts. Focus groups, surveys, and in-depth interviews were all part of it. The study discovered that the tendency to poison oneself with pesticides is the same for both sexes. Few people were aware of the risks that pesticides posed to the environment, agricultural productivity, and human health, and the majority of residences lacked secure storage facilities for these substances. Actually, they didn't take many or any safeguards.

2.2 Trace Elements Contamination

As a means of determining the impact of wastewater irrigation on heavy metal pollution, Sharma et al. (2007) examined summer and winter samples of "palak," or Beta vulgaris, spinach, and analysed them for Cd, Cu, Zn, Pb, Cr, Mn, and Ni. Researchers in the Varanasi suburbs collected samples of the treated and untreated wastewater that was irrigated by three big plots. Results demonstrated that, with the exception of Cd, the concentration of heavy metals in irrigation water was lower than the maximum permitted values stipulated by the World Health Organisation (WHO) for agricultural use at all locations. Similarly, while heavy metal concentrations in the soil were generally below the permitted limits set by India, the highest reported figure of Cd occurred in January, which was over the norm. In contrast to the winter and summer edible sections of B. vulgaris, which had higher levels of Pb and Ni, the summer edible component had a Cd content that was higher than the Indian standard's permissible limits. According to the results of the linear regression analysis, there is a positive and statistically significant relationship between soil Zn loading and contamination of winter vegetables. This summer, the only correlations between soil and plant concentrations of Cd, Cu, and Mn were positive and statistically significant. Levels of lead, zinc, cadmium, and nickel were negatively correlated with soil and plant contamination throughout the year. Scientists have discovered that using both treated and untreated wastewater for irrigation has increased the contamination of edible plants with Cd, Pb, and Ni. Potentially harmful effects on health could be felt for some time after this incident.

Using a sample of 80 farmers and utilizing correlation and multiple linear regression, Naik et al. (2009) evaluated the degree and variables impacting knowledge of organic

farming methods in four districts in the state of Haryana namely, Hisar, Sirsa, Karnal, and Kurukshetra. The results showed that almost half the farmers have a high level of knowledge regarding organic farming techniques, while a small percentage possessed a poor level of knowledge and the rest possessed a medium level of knowledge. There was a favorable and statistically significant relationship between knowledge level and education, media exposure, and inventiveness.

2.3 Cropping Patterns and Pesticide Contaminants

The services provided by ecosystems, as defined by Killebrew and Wolff (2010) of the Evans School of Public Affairs, include providing people with clean water, food, feed, fiber, energy, biodiversity, and nutrient cycling, among other benefits. Both good and bad effects on the ecosystem functioning may be discernible in agricultural output. The Millennium Ecosystem Assessment (2005) found that throughout the last fifty years, there has been a general decrease in the availability of services other than food, feed, and fiber due to trade-offs caused by the increased global food production. Agricultural practices and technology have an effect on soil fertility, water, biodiversity, air, and climate, among other ecosystem services, as this paper outlines. By increasing the number of crops planted every year, paring down the recurrent cultivation of contemporary varieties, and making greater use of external inputs, the intensification enables farmers to achieve better yields per unit of time and space (Cassman & Pingali, 1995).

In the district of Jalpaiguri, West Bengal, tea plantation is the main cash crop, hence Bishnu, Avhik, and Chakrabarti Kalyan (2010) chose two research sites: one in the Dooars and one in the Hill area. The current research found that in order to increase output, certain West Bengali tea plantations use pesticides indiscriminatedly leaving harmful residues in the soil. Despite being outlawed, heptachlor is evidently being widely used at levels over its maximum permitted residual limits (MRLs), posing a significant risk to consumers' health. Organically maintained gardens in the Hills also had superior soil quality preservation, according to the data. Applying pesticides like ethion at the approved field rates does not seem to harm the soil biological ecology, and only traditional tea gardens in the Dooars and Hills were found to have pesticide residues, in varying proportions.

The Kapotaksha River's water pollution and its impact on human health and the ecosystem were evaluated by Hanif MA et al. (2020). Four distinct locations—Barakpur, Srirampur, Prbazar, and Gouranandapur—on the banks of the Kapotaksha River in Jhikargas Upazila were the focus of case studies. River water contamination can be caused by natural events like floods and storms, but human activities including urbanisation, industrialisation, sewage systems, domestic waste, and agrochemicals are the main offenders.

Kaushik et al. presented the first investigation on the Ghaggar River's pesticide contamination in Haryana (2010). The 230-kilometer stretch of the Haryana river was examined for the presence of organochlorine pesticide residues. While aldrin and dieldrin were detected in lesser concentrations, dichloro diphenyltrichloroethane (DDT) and hexachlorocyclohexane (HCH) were detected in all water samples. Sigma HCH's high beta-HCH content indicates that the cause of the pollution is ancient, while Sigma DDT's predominance of p,p'-DDT indicates that it has just recently been utilised in the river's catchment area. A European Commission directive states that HCH and DDT levels in all samples were higher than what is deemed safe for human consumption.

According to a review by Agrawal et al. (2010), pesticides can have both positive and negative impacts on people and other species. There are numerous benefits to using pesticides, including a notable reduction in vector-borne diseases and an increase in agricultural and food production. Nonetheless, there are justifiable worries over these pesticides' effects on people, wildlife, and the ecosystem at large due to their extensive and careless usage. Despite being prohibited in many countries, the use of pesticides like organochlorines—which are highly persistent and do not biodegrade—is growing. Because of their rapid fat solubility and ability to bioaccumulate in non-target animals, pesticides provide serious health concerns to biological systems. This is due to the fact that even at low doses, pesticides may have a number of detrimental consequences that can be investigated at the molecular, behavioural, or biochemical levels. Numerous factors, such as runoff, precipitation, microorganisms, soil temperature, treatment surface, rate of application, and the solubility, mobility, and half-life of the chemicals, contribute to the endangerment of pesticides and their residues in water systems.

According to a survey, organo chlorine pesticides like DDT and HCH account for more than 70% of all pesticides used in India. Both municipal water systems and mineral water samples from bottled water bottles appear to contain significant levels of pesticides, according to data from urban areas like Delhi and Bhopal as well as some rural areas. The effects of pesticide contamination on India's river and drinking water systems have also been discussed.

Organic farming techniques for rice growing in the Jabalpur district of Madhya Pradesh state were investigated by Namdev et al. (2011) in relation to the socio-economic and production restricting limitations. The majority of organic paddy farmers face the following challenges:

(1) Low crop yields,

(2) Unfamiliarity with recommended practice packages,

(3) Insufficient funding,

(4) Input material shortage during cultivation,

(5) Expensive seed,

(6) Lack of improved seed,

(7) Ignorance regarding seed variety and rate.

The main marketing obstacles were the escalating prices and the absence of agencies that might help with the purchasing of organic goods. Inadequate government facilities, inadequate instructions, few visits from agricultural authorities, and a lack of testing facilities were additional significant limitations.

According to Savci Serpil's (2012) overview of research on the environmental effects of chemical fertilizers, people need more farmland per unit area to make the most efficient use of their land and produce the best possible food. The purpose of this study is twofold: first, to identify environmental and health issues brought about by incorrect fertilization; and second, to provide solutions to these concerns. Plant nutrition is a major component in regulating agricultural output and quality, whereas soil nutrient rates impact crop quality. Soil on permanent agricultural land is often inefficient and nutrient-poor because of the constant usage it gets. Soil fertilization, insect control, irrigation, and other agricultural practices may help farmers withstand

this difficulty. Increasing the amount of fertilizer used in subsequent years can possibly improve crop yields. Fertilizers contribute to the build-up of inorganic pollutants and heavy metals (such as cadmium and chromium) in plants due to their high radionuclide concentrations and heavy metal content (Cerve et al, 2004). During the peak season it was observed that greenhouses and aquaculture utilize huge quantities of chemical fertilizers, which may damage well water and other water resources. As a result, crop output quantity and quality decline.

To examine the spatial and temporal fluctuations in water quality, Kundu et al. (2012) used descriptive and principal component analysis on the surface water data set of the Ghaggar River, which was monitored in June 2006 and 2007. Due to the high quantities seen for several water components throughout the summer season, two of these findings were considered. The chemical and physical properties, including pH, total dissolved solids (TDS), electrical conductivity (EC), temperature, chloride, bicarbonate, carbonate ions, magnesium, sodium, potassium, calcium, fluoride, sulfate, and bicarbonate ions, were examined. The statistical analysis showed that the water quality factors changed significantly between the two summertime readings.

Researchers Dey and Dutta (2013) investigated the usage of several pesticides in agriculture and their potential effects on farmers' health in three districts of the Barak valley in Assam, India: Char, Karimganj, and Hailakandi. Organochlorides, organophosphates, and carbamates are among the very dangerous pesticides used by farmers, according to the results. There was a relatively high risk (RR) and a wide range of symptoms indicative of illnesses and physiological abnormalities. The researchers discovered that farmers in the area are in worse conditions than before since they had not taken adequate requisite precautions.

Chemical fertilizers and pesticides have severe negative impact on human health, both when consumed directly and when absorbed through the contaminated environment (Kumari et al., 2014). Their paper outlines the primary challenges of today's globe, which include soil contamination and pollution. The report states that various pesticides and fertilizers, totaling over 300 million pounds of chemical poison, are currently being manufactured (Tomkins & Bird, 2002). This article lays forth a number of facts about pesticides and their negative effects, such as how the overuse of synthetic fertilizers and pesticides has harmed the environment and, by extension the

people living in its proximity. Consistent usage also makes the insect more resistant, making it harder to manage with other methods. Additionally, when plants are fertilized with synthetic chemical fertilizers, the protein in their leaves is improperly formed. This causes crop failure and, eventually, disease in people and other animals that eat this food (Talukdar et.al., 2003). Several studied show that it will have an impact on future generations owing to the high levels of toxic chemical residues in the soil. The research found that as compared to the typical American, the Indians consume almost 40 times more pesticides via food products. Pollution occurs at both the application and production sites of chemical fertilizers due to their excessive usage. Although the trace levels of pesticides in food do not have any noticeable effect right away, they tend to pose health risks if ingested regularly over a period of time. A significant amount of the nitrogen fertilizers treating soil are water soluble, meaning that they do not become accessible only to the plants but to the soil as well. They seep into the groundwater via runoff or leaching. Rivers and ponds that have had too much nitrate leached into them support an abundance of organisms, which in turn produce a great deal of organic debris, which, when decayed, gives off a foul odor and is harmful to human health.

The water of the River Ghaggar, a significant river in the northern Indian State of Haryana, was the focus of the research conducted by Sharma et al. (2014). Its birthplace is the Himalayan mountain range. The Ghaggar River is receiving untreated effluents from a number of point and non-point sources at locations throughout Himachal Pradesh and Punjab. The results demonstrated that industrial effluents polluted the water samples with their physical and chemical qualities. Samples were taken at 15-day intervals from five distinct locations, each of which was 50 meters apart. According to Ramteke et al. (2016), who compared various parameters with W.H.O. standard values, many people around the world consume vegetables as part of their regular diet. This is because vegetables are rich in nutrients, antioxidants, and metabolites, and they also act as a buffer for the acidic substances that are produced during digestion. Heavy metal contamination of industrial area veggies, however, compromised human biochemical and biological processes. Researchers in Korba, the biggest coal-burning basin in India, have described the risks of eating common vegetables like Coriandrum sativum, Amaranthus tricolour L., Chenopodium album L., Spinacia oleracea, Solanum lycopersicum, and Solanum melongena because they

are tainted with heavy metals (Fe, As, Cr, Mn, Cu, Zn, Pb, Cd, and Hg). The soil of the study site had high levels of toxic metals as arsenate, lead, and mercury, which found their way into the vegetables.

2.4 Anthropology and Agriculture – The Interface

There is a substantial link between anthropology and agriculture, according to the essay. Agricultural Anthropology is essential for studying agricultural topics through an anthropological lens, such as the preservation of agro-biodiversity, the adoption of new technologies by farmers, and the presence of pests and diseases that affect crops. To create participatory technology for sustainable agriculture, this research study suggests that agricultural sciences and allied fields should include Agricultural Anthropology.

In order to determine the level of awareness, perspective, and experience with pesticides as well as any health issues associated with their usage among irrigation-dependent farmers in Jimma Zone, Southwest Ethiopia, it was Gesesew et al. (2016) who performed a community-based cross-sectional research. A total of 796 irrigation farmers from 20 kebeles (the lowest administrative unit) in Jimma Zone, a region 357 kilometers Southwest of Ethiopia's capital Addis Ababa, participated in the survey. Data was gathered using a standardized questionnaire that had been pilot tested. Analyses were conducted using both descriptive and inferential statistics. The parameters linked to farmers' attitudes regarding the safe use of pesticides were identified in the final model using a binary logistic regression with a significance level of $P < 0.05$. For many different reasons, pesticides were extensively employed in Ethiopia. Researchers found that pesticide exposure is common, that pesticide usage is low in a safe way, and that personal protective equipment (PPE) is underutilized. The farmers' opinions regarding the safe use of pesticides were encouraging, nevertheless. These results highlight the need for more robust public health initiatives to raise farmers' PPE safety consciousness and educate them on its proper usage. Furthermore, in order to avoid serious health problems that might arise from the improper and harmful use of pesticides, it is necessary to educate farmers about integrated pest management.

In their review study, Ayenew Abayneh Wubetu (2016) combed through scholarly journals, conference proceedings, theses, yearly reports, fact sheets, and other

publications that dealt with the topic of irrigation water pollution and how to reduce it. Documentation has been was provided for the following aspects of irrigation water pollution: definition, categorization, dangers, and methods for minimization. There was also a reasonable evaluation and presentation of indicators, causes, status, demographics, and socioeconomics related to irrigation water contamination and ways to reduce it. Efficient management of water and chemical inputs, as well as control of runoff to reduce irrigation water pollution, are both possible. Among these methods are the following: pre-treatment of sewage and storm water; effective management of irrigation water; integrated pest control; management of animal waste; conservation of agricultural and industrial waste; and comprehensive planning for nutrient management.

Sarwar Muhammad (2016) explained how pesticides affect the human body including how they affect different functions and how vulnerable all humans and animals beside plants are to exposure. Inadequate monitoring of pesticide application, not washing bedding coated with pesticide, and excessive insecticide treatment were major factors leading to disease. The most common adverse effects of pesticides, which include pyrethroids, pyrethrins, and many more, include headaches, dizziness, and respiratory issues like irritation and pain in the upper respiratory tract as well as dyspnea, and gastrointestinal problems like nausea and vomiting. There are a number of ways in which pesticide exposure may interfere with hormonal function, but research on the effects on estrogen and androgen receptors is limited. Babies whose parents are exposed to pesticides are more likely to be born with health problems, and research suggests that these chemicals might weaken the immune systems of young children. Educating the public on effective vector management is just one step in limiting pesticide exposures to children, men, and women.

According to research by Sharma et al. (2016), agricultural produce grown close to wastewater drains is unfit for human consumption. The hazard quotient for leafy and tuberous vegetables was higher than the allowable levels for all areas, irrespective of irrigation technique, suggesting that eating these foods is dangerous. Spinach was the most hazardous of the group due to its highest cobalt and copper hazard ratio. Trends in the absorption of metals such as iron, cobalt, copper, cadmium, and lead by all other vegetables are listed in order of significance. The location that received groundwater irrigation but was otherwise close to the waste water drain had the

greatest concentrations of copper (81.33 mg/kg) and cadmium (1.20 mg/kg). Several vegetables in every region had levels of cadmium, a potential carcinogen, over the permissible limits. Regarding the concentrations of lead and copper in vegetable samples at various sites, no statistically significant variation was found.

Bekele and Bekele (2017) emphasise the environmental and social effects on agricultural growth and food security, primarily due to the estimated need to raise food production by 60–70% by 2050 in order to feed the world's growing population. Due to a lack of social, technological, and financial resources, they contend that less developed nations are less equipped to tackle climate change, which will negatively impact agricultural productivity and present additional challenges to attaining food security. Their findings provide insight into the socioeconomic and environmental issues influencing agricultural productivity in emerging nations, which have an impact on not just farmers but also institutions, policymakers, and other industry participants. Given these prevailing social and environmental issues, a great deal of study has focused on developing economies.

In a review, Rohila A.K. et al. (2017) established a connection between agriculture and the environment, as well as the effects of agriculture on the latter. Since agriculture relies on the usage of natural resources, this shows that the environment directly affects the existence and sustainability of the industry. With a third of the planet's land area devoted to farming, this human occupation is the most destructive to Earth's ecosystems. Conventional agricultural methods will not be able to meet the future demand for food and fiber. Therefore, in order to contribute to sustainability in the long run, it is necessary to develop and implement contemporary agricultural and farming methods that can provide enough food to support the vastly expanding urban population. While new machinery, seed varieties, and agricultural techniques are great for increasing yields, they are having a negative impact on the environment.

In an effort to present Agricultural Anthropology as the game-changer for sustainable agriculture, Sarker Md Nazirul Islam (2017) presented an essay with that goal in mind. A better grasp of Agricultural Anthropology and its relationship to the field as a whole is provided by this review piece. A meta-analysis was carried out to achieve the study's goals.

2.5 Changed Agricultural Interface Before and Due to Urbanization

Lewandowski et al. (2017) define agriculture in depth describing it as the raising of crops or cattle in either pure or integrated crop/animal production systems with the dual goals of producing food and biomass for material and energy needs. The bio-economy is primarily concerned with the production and supply of resources related to agriculture and forestry, including food, starch, sugar, and vegetable oil. At present, 2.5 billion people rely on the agricultural sector, which occupies 33% (or around 4900 Mha) of the Earth's land area. The agricultural sector is responsible for 13.5 percent of the world's Green House Gas emissions, the loss of biodiversity, and the degradation of water and land resources, among other negative impacts on cultural landscapes (IPCC 2006). Sustainable intensification can be achieved, in part, by the creation and application of new production methods that make better use of available resources. Land, agricultural inputs, and application of this knowledge-based strategy are all part of it. This program educates farmers on the need of sustainable production and provides them with the skills they need to put sustainable agricultural production methods into practice.

From 1985 to 2015, the hydrological components of the Ghaggar river basin were examined by Chauhan et al. (2020) using the Soil and Water Assessment Tool Model to determine the effects of land use and landcover changes. Maps of land cover and land usage were constructed from a variety of Landsat satellite pictures taken between 1985 and 2015. By keeping all other inputs constant and scaling land use maps from different years, we were able to apply the fixing modifying approach to quantify the effects of land use changes on hydrological components. The impact of land use changes on the hydrological components was investigated using partial least squares regression and correlation. While areas of mixed forests, evergreens, and deciduous trees shrank, those of agriculture and cities shrank much more. There was an increase of 12.23% in surface runoff, 0.22% in water output, 0.20% in annual stream flow, and 1.55% in wet season streamflow between 1985 and 2015. Changes in landuse and landcover, on the other hand, reduced evapotranspiration (0.08%), groundwater flow (8.62%), percolation (8.02%), lateral flow (3.92%), and dry season streamflow (2.1%).

The frequency of water-borne diseases caused by industrial pollution of the Ghaggar River was determined by a survey of locals conducted by Pareek et al. (2020). The results showed that the Ghaggar River's water was not fit for human or aquatic consumption due to its low dissolved oxygen level and other tested criteria. At their maximum levels, the following parameters were measured: colour, pH, turbidity, total dissolved solids (TDS), chemical oxygen demand (COD), and biochemical oxygen demand (BOD). These parameters were 36 mg/l, 500 ptcu, 8.6, 1321 mg/l, 161 mg/l, 301 NTU, and 265 mg/l, respectively. Poor water quality is likely indicated by the river's big population. Locals endured devastating waves of jaundice, diarrhoea, typhoid, hepatitis, and malaria, among several other water-borne diseases. In all, 49% of individuals suffered from scabies, 4% from diarrhoea, 5% from dysentery, 25% from respiratory disorders, and 4% from asthma. Methods of farming that make use of polluted water accelerate the degradation of the soil. The river water is becoming more polluted and poses risks to humans and the environment due to a combination of factors, including the actions of local traders and residents, inadequate management of the sewage system, improper use of the riverside area for the disposal of solid waste, chemical fertilisers, and industries.

Kapur Radhika (2019) aimed to understand the role of the agricultural sector in rural communities by conducting a review research on the importance of the agricultural sector in rural regions. Farming is the main source of income for many people in rural regions, and people of both sexes work the land. Improving productivity, which is directly related to profitability, is the primary goal of agricultural laborers, according to the survey. Scientific, sophisticated, and inventive manufacturing techniques are used to achieve this goal, leading to breakthroughs in these approaches. Some farmers, especially those on the margins, rely on tried-and-true techniques to boost their yield. This study paper primarily delves into the importance of the agriculture sector's growth, the diversification of agriculture towards high-value commodities, rural development, and ways to enhance agricultural production and farmers' circumstances. In addition, it was found that farmers and agricultural laborers in rural areas are enrolling in training centers to improve their expertise and raise awareness about scientific procedures. It is important to acknowledge the needs of these rural people as they are also urged to establish policies and initiatives.

Balogh and Jámbor's (2020) review study set out to do just that, drawing on a literature based assessment of recent publications in the field of international economics, to provide a synopsis of the effects of environmental factors on agricultural commerce. Recent environmental studies have shown that they do not see agricultural trade liberalization or expanded trade in a positive light. The main issues that have been raised in relation to the rapid trading of agri-food products are soil erosion, water shortages, deforestation, biodiversity loss, and excessive water consumption in agriculture. Water shortages have become more common in the Middle East, South Asia, and Southeast Asia since trade liberalization. The detrimental effects of increasing soybean output on both the exporting and importing areas were seen in Brazil and Argentina. The former saw deforestation and grassland conversion, while the latter saw a drop in permanent grassland due to the replacement of grass as milch animal fodder. The findings highlight the most pressing effects of pollution and suggest ways to mitigate them.

The effects of the COVID-19 shutdown on India's agricultural sector were examined by Saha and Bhattacharya (2020). Although agricultural facilities were not subject to the lockdown, the attention was on the significant difficulties encountered by farmers. A dearth of migrant workers meant that farmers could not harvest their crops, therefore the food went to waste. The writers go over the ways in which the government and ICAR are keeping an eye on things to ensure the country's food supply and increase farmers' incomes. The responsibilities of Farmer Producer Organizations (FPOs) in addressing the difficulties encountered during the COVID-19 pandemic have also been discussed in Kale and Nikam[2]. Urban customers are either dealing with a lack of availability or paying exorbitant prices for rural items since farmers had trouble selling their crops during the lockout. In this blog post, are details of how certain governments are turning to Farmers Producer Organizations (FPOs) to facilitate the buying and selling of agricultural products by collecting the harvests of their members and distributing them to stores in cities. There have been certain challenges for the numerous FPOs during the COVID-19 pandemic to purchase and sell farmers' goods, providing much-needed revenue to farmers. Problems with infrastructure, a lack of available workers and supplies, and sometimes unhelpful local governments hinder their ability to serve farmers and customers. Some FPOs

[2] Blog 110 April (2020)

had to halt their supply chain activities due to these limitations. "Unshackling Farmer Producer Organizations from the COVID-19 Lockdown" a blog post by A. Nagaraj and B. Mangalagowri (2020) focused on the transformation of agricultural land in the Mysore district from one kind of land to another during a certain time span in their research (2020). A comprehensive image of the many parts where agricultural land is being transformed is shown, with an emphasis on the previous several decades. It is possible to predict the future conversion of agricultural lands and the development of various sectors in the taluks of Mysore by analyzing the data. Researchers found that when the government bought farmland from the farmers for development projects, they did not pay enough to compensate them. The government should enact stringent regulations against the purchase of farmland. In their study, Agrawal et al. (2020) examined how the COVID-19 pandemic impacted the Indian economy and supply networks. In addition to reporting on the COVID-19 influence on worldwide manufacturing, the research identified 18 significant impediments that have an impact on Indian supply chains. Already, hundreds of enterprises in the United States, Europe, and even emerging countries like India had to temporarily regulate or shut down their manufacturing lines due to the impact of the COVID-19 viral surge on the supply chain. According to the research, using conceptual models to get over this problem can be useful. From the beginning of 2020 until March, when the coronavirus started to spread to other nations and markets, Ozili and Arun's (2020) research concentrated on that time period. Measures pertaining to public health, monetary policy, fiscal policy, and restrictions were all monitored in order to evaluate their efficacy over that time. Economic activity and stock market indexes were studied to determine the effect of social distancing measures. Financial policy changes, foreign travel restrictions, and the growing number of lockdown days all had a significant impact on economic activity and the opening, closing, lowest, and highest stock prices of key stock market indexes, according to the data.

In a study conducted by Pandaret in the Faridkot district of Punjab, six villages—Killa Nau, Sukhan Wala, and Tehna in 2015-16 and Sikhan Wala, Behlewal, and Khara in 2016-17—were studied in detail. The results showed that higher fiscal policy spending and restrictions on internal movement stimulated economic activity. In contrast, the rising number of confirmed coronavirus cases had no discernible effect on economic activity. There were 594 randomly chosen farmers and agricultural

workers/labourers (henceforth referred to as "farmers") who were surveyed using a pre-tested questionnaire for the purpose of primary data collection. People were polled both before and after an education campaign that highlighted the severity of pesticide usage on cotton, rice, and vegetable crops. In order to educate farmers and assist them in understanding the risks of pesticide usage, the research set out to assess the current state of safe pesticide use and implement comprehensive training and awareness programs. A number of interactions, including training sessions, street plays, literature distribution, school quizzes, etc., greatly contributed to raising farmers' understanding of many elements of pesticide safety (11.4-27.3%) and usage.

A study was carried out in the Karnal and Sirsa districts of Haryana by Baskaur and Tyagi in 2021. Sixty participants were surveyed. One block was chosen at random from each district. The results showed that over 60% of respondents from nuclear families were not very knowledgeable about organic vegetable crops. Conversely, among those who identified as belonging to joint families, 44.4% had an excellent understanding of organic vegetable crops. There was a significantly substantial connection between yearly family income and degree of knowledge. The correlation between yearly revenue from organic vegetable crops and knowledge level was really significant. Researchers discovered that among those with low levels of social involvement, 56.5% had a high level of adoption of organic crops, while among those with no degree of participation, 50.0% had a medium level of adoption. The correlation between exposure to mass media and adoption rate was quite significant.

Sharma et al. (2021) explored the groundwater in the Punjabi town of Dera Bassi and the agricultural area nearby to determine its suitability for irrigation and drinking water. As part of the investigation, thirty samples of groundwater were taken in February 2020 and tested for several physicochemical elements. Analysing the physicochemical parameters of the groundwater samples in comparison to Indian (IS 10500:2012) and World Health Organisation (2006) recommendations allowed us to determine that, with the exception of alkalinity at a few spots, the water was safe to drink. Moreover, the groundwater samples were determined to be suitable for irrigation based on the measured permeability index, corrosivity ratio, sodium adsorption ratio, sodium percentage, and Kelly's ratio. Yet, several locations in the investigated groundwater basin were deemed unsuitable for irrigation due to the

remaining sodium carbonate and magnesium ratio. Water type C3-S1 (high salinity—low SAR) was the most common, with the majority of samples falling into this category. Water type C2-S1 (medium salinity—low SAR), comprising 36.77 percent of the samples, was also rather common.

Researchers Shahapur and Pote (2021) used a purposive sampling technique to examine data from two talukas in the Yadgir district of the Indian state of Karnataka. The two talukas were Shorapur and Shahapur. Two hundred households (including husbands and wives) and four hundred respondents were drawn at random from each taluka; fifty farm families were drawn from each hamlet. The data was gathered via in-person interviews using prearranged schedules. For the sake of interpretation and analysis, percentages and frequencies were used. Climate, seeds, fertilizer, irrigation, plant protection, labor scarcity, and marketing were some of the issues that respondents mentioned while growing cotton.

CHAPTER 3
THE RESEARCH DESIGN

In any study, the research technique is crucial and entails using a methodical approach to obtain reliable data that answers the research questions. All aspects of the data collection and analysis process are included in it. The credibility of the study and the quality of its findings are both enhanced by using appropriate techniques. Research methodology helps the researcher understand the procedures and approaches used to arrive at the results.

Qualitative, quantitative, or mixed methods research approaches are valid for gathering and analyzing textual or spoken expressions that constitute empirical research. Interviews, focus groups, and observations are the main methods used to collect qualitative data. Research with exploratory goals and objectives is dependent on qualitative approaches. Researchers working with quantitative data often rely on gathering, analyzing, and quantifying numerical data from a large sample of people. Statistical analysis and comparisons are then used to examine the data. Its primary use is in research when the aim is to provide conclusive evidence. The qualitative approach was used for this investigation.

The research design provides a rational foundation for the apparently endless choices associated with data collecting, processing, and analysis, according to Manheim (1977:140). It is "a master plan outlining the methodologies and processes for gathering and analyzing the necessary information," according to Zikmund (1988:41).

Here are the six steps that make up a research process:

- ✓ Designating the issue or subject for investigation.
- ✓ Creating a plan for the study.
- ✓ Sampling strategy (probability, non-probability, or a mix of the two).
- ✓ Data collection.
- ✓ Examining the data via processing, tabulating, revising, and coding.
- ✓ Preparation of the Report of the findings discussions and outcomes of the research.

Qualitative and quantitative approaches may coexist in research. Quantitative research involves the formulation of hypotheses prior to conducting the study, using a prescriptive design, and operationalizing ideas. Qualitative research, however, does not adhere to a prescriptive design, providing the hypotheses either before or after the study has begun. Conceptual clarity and theoretical understanding of scientific behavioral investigations are prerequisites for qualitative research (Ahuja, 2011).

When research goals are established, it is deemed significant. The area of inquiry is guided by the goals. Answers to questions may be found by the use of scientific techniques in any inquiry.

3.1 Land and People:

Despite using 83% of its land for agriculture, Punjab only accounts for 1.57% of the country's total geographical area, or 50,362 km^2 (Gupta, 2009). This is far lower than the national average of 40.4 percent. Both, the total planted area and the cropping intensity in the State have almost doubled since the late 1960s. A total of 1.3 percent of the State's agricultural land is irrigated in some other way, while 26.2 percent is watered by canals and 72.5 percent by tube wells (GoI, 2019). Inputs like land, money, energy, fertilizers, and agricultural water are increasingly being used intensively in the State's agriculture. The State's population grew from 27,704,234 (or about 27.7 million) in 2011 to 30,452,879 (or about 30.5 million) in 2018 Anonymous (2019). In the past, when the Green Revolution was in full swing (thanks to both institutional and technological factors), Punjab saw a meteoric rise in agricultural output, earning it the titles of "Food Basket of the Country" and "Granary of India" for its substantial contributions to India's rice and wheat supplies.

Punjab is between 73°550 and 76°500 degrees east longitude and 29°300 and 32°320 degrees north latitude, with an elevation of 230–700 meters above mean sea level. The geographical divisions of Punjab are North-East, Central, and South-West. In comparison to the Central and South-West zones, which each cover 40 percent of the state's area, the North-East zone only covers 19.40 percent. Soil erosion in the state's northeastern region is mostly caused by water, with an annual rate of 80 t/ha. In the South-West zone of Punjab, water logging and poor water quality are major problems, while in the Central zone, fresh groundwater supplies are quickly diminishing. The

Ghaggar is a seasonal river, whereas the Beas, Satluj, and Ravi flow through Punjab all year round. It can extract water from these rivers via a network of canals covering about 14,500 km. Annual precipitation in the state typically falls between 1,250 millimetres in the north and 350 millimetres in the south-west. During the monsoon season (July–September), over 70% of the year's precipitation falls. Conversely, between 1994 and 2014, there was a 40–50 percent drop in precipitation (PWRED, 2014). Due to over-exploitation, the state's fresh groundwater supplies have been quickly declining over the past few decades.

Map 1: Punjab

Source: https://www.mapsofindia.com/maps/punjab/

From the Himachal Pradesh and Haryana Siwalik Hills flows the Ghaggar, a significant river in the State. Following the foothills of the Siwalik Hills, it flows through Punjab and Haryana until reaching Rajasthan, where it vanishes into the Thar Desert. The selected research region included portions of several districts in the Indian states of Punjab, Haryana, and Rajasthan, and stretches beyond the boundaries of many States. In terms of latitude, the region spans from 30^{0}Ë/45′5.93″ to 29°11′49.29″ in the North and 76Ë54′36.79″ to 73Ë13′26.88″ in the East. A number of districts in Haryana and Punjab, including Panchkula, SAS Nagar (Mohali), Patiala, Ambala, and Kaithal, make up the selected study region. A wide variety of point and non-point sources are adding to the river's pollution load in downstream locations. Although the river is used for livestock drinking and bathing, its primary purpose is as a disposal site for industrial, agricultural, and urban runoff.

Map 2: River of Punajb

3.2 Objectives of Research

Research goals provide a concise description of the intended outcomes of the research. An objective statement gives direction to a study and summarizes the researcher's intentions for the project's implementation.

The objectives of the present study have been delineated as follows:

1. To examine the demographic makeup of the research area's respondents.
2. To understand which diseases are prevalent in the study locations and what causes them.
3. To learn about the villagers' perceptions and acceptance of organic farming.
4. To examine how agriculture affects human health.

To fulfil the objectives, in-depth interviews were conducted with the respondents and following tools of investigation were used:

(a) Schedule of Interview

(b) Case Studies

(c) Socio-economic status

(d) In-Depth-interview

(e) Observations

3.3 The Universe of Study

The number of people that make up a research sample is known as the sample size. It also means the total number of people surveyed or the total number of observations made. The standard notation for this number is "n".

One hundred people who were farmers by livelihood and had legal title to their property were surveyed for this study. To examine the health conditions and the direct correlation between the usage of contaminated Ghaggar water for farming and the current research focused on areas around the river. Since this water was used for both agricultural and residential purposes, the river strongly impacts on the people who lived along or near it.

3.4 Pilot Study

A pilot study is conducted as a pre-test. It is a small-scale exploratory study that ensures everything is feasible and to refine the research plan. Prior to carrying out a full-scale research project, a pilot studies may play a crucial role in designing the research methodologies.

Haibatpur, Saidpura, Sanoli, and Bhankarpur are four villages in the Dera Bassi Tehsil of the Sahibzada Ajit Singh Nagar district in Punjab that were the first sites of fieldwork for the preliminary research. The process took place over the course of one month and three installments. The main objective was to measure the distance between the field regions and river Ghaggar, and there was also an effort to determine how the villagers would be affected by the river's pollution.

3.5 Methods of Data Collection

One can accomplish the goals, evaluate the findings, and respond to research questions by collecting and evaluating data on pertinent elements in a planned and systematic manner. Getting high-quality evidence that can be used for in-depth analysis and to create a convincing and credible response to research questions is the aim of data collection. Qualitative and quantitative are the two primary categories of data. Because quantitative data can be calculated mathematically, it is measured using a variety of scales, such as ordinal, nominal, interval, and ratio scales.

3.6 Material Methods

3.6.1 Sampling

A "sample" is a small subset chosen at random from a larger total. As an alternative summary, "the sample gives a specimen image of a greater whole". Sampling is a way to get a smaller, more manageable representation of a bigger population. It is a smaller subset that represents a bigger population. The sampling is a strategy that researchers use to analyze a subset of a larger population in order to draw conclusions about that population as a whole.

Within this study, the sample was chosen using the snowball sampling approach. It all started with talking to the local Sarpanch, and then the heads of household of others in the village. The interviewees were limited to landowner Punjabi farmers. The field work was conducted from September 2017 and December 2019 for the present study.

Data gathering is required in order to evaluate findings, test hypotheses, and respond to research questions. It involves gathering data on pertinent variables and measuring them in a methodical and defined way. For their research, anthropologists use a range of techniques, such as case studies, interviews, questionnaires, and timetables. We combined primary and secondary sources in this anthropological study.

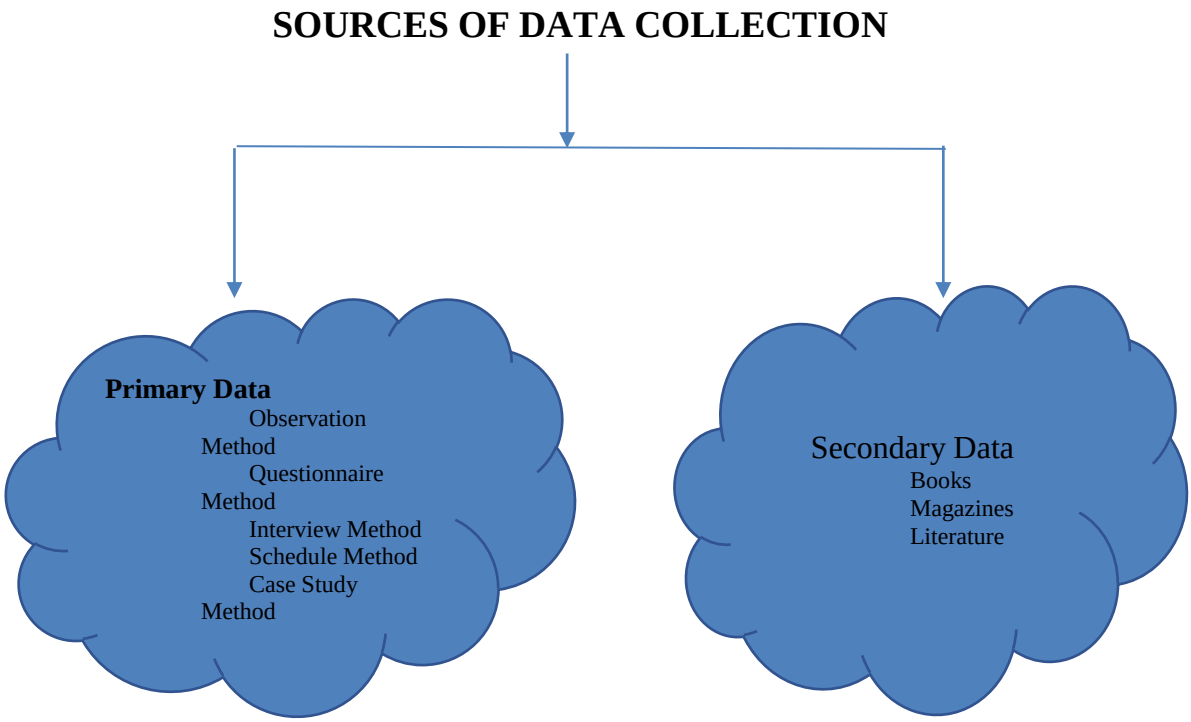


Figure 6: Sources of data collection

3.6.2 Data

The data for the present study consists of a sample of 100 respondents. The data collection involved personal interview based on structured schedule, Case study, In-depth Interview, Observation. Focussed Group Discussion were also conducted. Evening time was decided because the people belonging to the older age group find it a leisure and free time. They could easily communicate and impart knowledge to the researcher.

3.7 Tools of Primary data collection

3.7.1 Schedule for Interviews

In order to get information from the interviewees, a timetable is used. Questions and statements are the building blocks of a schedule, which also includes tables and blank

areas for respondents to fill up their ideas. Researchers hand out schedules to participants. The questions from the form were asked in the specified sequence, and the responses are recorded in the corresponding place on the form. It is also uncommon for researchers to brief respondents about the study's goals and objectives before providing them with schedules to fill out.

Structured schedules were used for collecting data from the respondents in the present research.

3.7.2 In-depth Interviews

"This method of data collection involves asking questions and getting answers from participants in a study. Interviewing processes can be of various types:

a) Individual

b) Face-to-face interviews

c) Face-to-face group interviewing

The asking and answering of questions can be mediated by the telephone or other electronic devices also."

In-depth interviews were carried out with the head of the family to understand the current scenario of the villagers. It also involved the demographic details of the respondents and other related information pertaining to the research title. Most of the research relied on information collected through in-depth interviews.

3.7.3. Observations

Observing the actions of people, groups, and organizations, as well as the results they produce, is not only fundamental to human existence but also a fundamental study technique in the field of behavioral sciences. Many branches of psychology and related disciplines rely on careful observation, including anthropology, evaluation research, social psychology, behavior modification, and developmental psychology.

The observation method is very helpful and unbiased as in this method the investigator observes the surroundings without asking the same from the respondent. Observation involves looking and listening very carefully. The researcher was required to play a number of roles and to use a number of techniques which included extreme sensitivities in order to collect data.

Quasi-participant observation was used to understand the socio-cultural background of the respondents. It included the day-to-day hassles they encountered and means to overcome those problems adopted by them, etc. When the researcher visited the village for the very first time he/she observed the dirty/polluted environment of the village, the poor sanitation and hygiene conditions. The researcher observed how people were reacting when being asked about the Ghaggar river water and its ill effect on their daily life. Initially, the researcher was accompanied by a villager who was a close friend of the *sarpanch* or the village leadman.

House to house visits and conducting observations gave a clear picture about their socio-economic status. It also helped the researcher in developing rapport for the very first time. The researcher focussed on the body language or visual elements and create a detailed description. During the first visit the information regarding the health and illnesses prevailing in the respondents homes was not disclosed.

3.7.4 Case study

To acquire data from several sources and utilizing numerous approaches, case studies involved the conduct of in-depth examination of a single individual, group, event, or community via observation and interviews. Clinical medicine (the patient's medical history, or case history) is where the case study research approach was first used. It also includes the idiographic method, which is only watching what occurs to one person or group of people (like a class or a social group) and piecing together their narrative. The researcher goes further into a subject by using the case studies method.

Definitions of Case Study:

- ✔ "Young, P.V. (1984) defined the Case study as a comprehensive study of a social unit, be it a person, a group of persons, an institute, a community or a family."
- ✔ "Groode and Hatt (1953): "It is a method of exploring and analysing the life of a social unit3."
- ✔ "Cooley, C.H. (2007): Case study depends upon the perception and gives clear insights into the life directory."

In the present study case studies were collected from the respondents to get an insight of their behavioural and psychological process. It helped the researcher to get high level detailed information.

3.8 Tools of Secondary Sources of Data Collection

Secondary data is the data that is collected from the primary sources which can be used in the current research study. Secondary data collection often requires lesser time than collecting primary data.

Secondary data was collected from the books on agricultural practices, pesticide uses, Organic farming etc etc. Published articles of journals and also some of the news-papers articles were used as secondary sources of data collection. Unpublished and published Ph.D. thesis, M.Phil dissertations related to the topic were also reviewed.

The information related to the industrial and domestic waste water impact on villages located along the Ghaggar or its tributaries was obtained from the reports generated by the Punjab Pollution Control Board (PPCB) as well as from Central Pollution Control Board (CPCB). The reports gave an outline of the pollution potential problem of the river Ghaggar.

3.9 Rapport Establishment

In research rapport building is an essential basis for successful communication. Rapport establishment once done not only increases the trust and mutual respect but also communication becomes more effective. Both researcher and participant develops a better understanding and trust with each other. Before beginning with the actual field work, few prior visits were made to the study area. A rapport was established with usually the heads of the villages and nearby areas. They were explained about the purpose of the visit and study.

3.10 Limitations and Difficulties Encountered

When the researcher decided to conduct this research in rural areas of Mohali district of Punjab initially her family objected to her decision. The researcher faced many problems during her fieldwork. Since the areas chosen for the present study were a remote village and the respondents were only males it was a difficult project for her to go alone during the field work. Each time she was accompanied by her husband or some other male family member to the research areas.

Also, during data collection the respondents were sometimes not willing to give answers. Sometimes they giving excuses of being busy and having no time for interview.

3.11 Analysis of data

The data collected and information generated through different modes of data collection has been analysed with appropriate statistical tests like the measure of percentage, and presented in the form of Tables, graphs, bar diagrams, pie-charts etc.

The qualitative data obtained with the help of case studies, have been analysed on the lines of propagated objectives to get a better insight of the problems (diseases) faced by the residents of the villages and the probable ways of coping with the problems. For the qualitative data, thematic analysis was done, interviews were analysed by the researcher, case studies and narratives have been given.

The data were analysed by the help of statistical tools of data analysis. Quantitative data such as demographic details were entered in MS Excel and tabular representation has been given. The data and responses obtained were coded and tabulated. The univariate statistics included frequency, percentage, mean, median and standard deviation, etc., the analysis of the data had been made to validate or in validate the objectives chosen for the present study. The entire data was analyzed in consultation with a statistical programmer, using computer Microsoft Excel for windows and SPSS software for windows.

The first objective is to "study the **demographic profile of the respondents of the study areas**. Demographic data refers to socioeconomic information expressed statistically, including employment, education, age groups, caste, income, marriage rates, birth and death rates, and more. The demographic data analysis is a population-based study on factors such as age, race, and sex etc. The demographic information is very important for determining whether the individuals represents the sample of the target populations. The demographic data was collected by interviewing the eldest individual of the family. The collected data was later on tallied with the demographic data given by the anganwadi/health workers to checks its accuracy.

The second objective was to know the **diseases prevailing in the study areas and the factors responsible for such disease.** Health and wellness (in its broadest sense), disease transmission and prevention, healing processes, social relations in therapy

management, cultural significance and use of pluralistic medical systems, and other topics are studied in medical anthropology by drawing on cultural, biological, and linguistic anthropology. Similarly, this research aimed to learn about the prevalent disorders in the places under investigation and what may be causing them, whether it be a cultural or biological factor or both. We made an effort to look at the policy, preventive, and intervention problems. It is also important to examine the power dynamics and socioeconomic factors that impact healthcare access.

The third objective is to find out how organic farming is seen and accepted by the locals. Such delicate and intimate information was gathered via rapport development, a crucial method in anthropological study. In addition, health care providers seldom visited the research region to inform locals about organic farming and its advantages.

The fourth objective of the present study was to **review the impact of agriculture on human health. A** complete and detailed brief of previous research on the above mentioned topic was done. The literature review from more than 60 scholarly articles, books, and other sources relevant to a particular area of research was done . The review enumerates, describes, summarizes, evaluate objectively and clarifies the previous research. Identifying potential gaps and loop holes in the previous studies and working on these shortcomings in the present work was taken care of.

The current study aimed to understand the connection between health and socio-cultural transformation as its ultimate goal. Multiple variables influence an individual's health, including heredity, lifestyle choices, availability of high-quality medical treatment, and environmental elements including air, water, and housing conditions. It is possible to think about social determinants of health as having an impact on people's health at various points in their lives. The current research found a correlation between health problems and socioeconomic position, which comprised three distinct indicators, namely,

(i) Income
(ii) Employment status
(iii) Educational achievement

CHAPTER 4
RESULTS AND DISCUSSION

Given the vast array of historical applications for river water, rivers have long been regarded as humanity's primary supply of freshwater. The physico-chemical properties and microbiological quality of river waters has been negatively impacted by the careless discharge of sewage, industrial waste, and an excess of other human activities (Chetanas and Somasekhar, 1997). The river Ghaggar, is located in the most agriculturally productive regions of Rajasthan, Punjab, and Haryana. It is the subject of the current study, which discusses the pollution of the river's water supply. Along its course, the Ghaggar River receives a steady flow of waste water from nearby industries and homes via a network of drains or 'Nalas' as well as direct discharge.

Researching the demographics of the people who lived in the locations under consideration was among the primary objectives of the research. Demography focuses on the study of human populations and how they vary over time due to factors like migration, fertility, and death rates (Poston and Bouvier, 2010). Anthropological demography seeks to shed light on demographic facts in the current and historical populations by drawing on anthropological theory and methodology (Bernardi, 2007).

The population of Punjab increased from 2.44 crore in the 2001 Census to 2.77 crore in the 2011 Census, according to data from that year. The most recent census estimates a total population of 27,743,338 for Punjab, with 14,639,465 males and 13,103,873 females. As compared to the preceding decade, the population growth rate is of 13.89%. In 2011, the residents of Punjab made up 2.29 percent of India's total population. According to data from the 2001 census the percentage was 2.37%.

The study of human populations is important to the fields of demography and anthropology. Size, structure, and variation in population over area and time are primarily defined by the dynamic factors that demographers study. Anthropology, on the other hand, places heavy emphasis on studying how different people react to diverse environmental and geographical factors. The need for agricultural labor in Punjab is driven by a combination of technical considerations and intricate market pressures. As a result of this massive demand, agricultural labourers from economically depressed eastern Indian States flock to Punjab in search of employment.

A term meaning "to tie tight" in Latin, the etymological source of the English word "religion" is religare. The term "religion" clearly connotes a heavy focus on communal elements. The members of the group are bound closely together by it. A few examples of the world's live faiths include Hinduism Judaism, Christianity, Islam, Sikhism, Jainism, Zoroastrianism, Buddhism, Jainism, Christianity, and Islam.

Guru Nanak (1469–1539) founded Sikhism, and nine more Gurus followed him, according to Sikh history. Guru Gobind Singh, the tenth Guru, lived from 1666 to 1708. After his death, the immortal Guru's soul was transferred to the holy Sikhism text, the Guru Granth Sahib, often called the Adi Granth or the "First Volume," which was then considered the only Guru. Approximately 25 million inhabit the Indian State of Punjab at the turn of the millennium.

Table 1: Prevalent religion in the study area

Religion	Percentage
Sikhism	100%

The field area has a huge population of these migrants. For the present study only Punjabi speaking Sikh respondents were interviewed. **Table 1** shows results from the field, it illustrates that almost all respondents followed Sikhism as their religion.

Table 2: Percentages of castes prevailing in study area

Castes prevailing in study area	**Percentage**
Banwait	6.0%
Gagian	1.0%
Harijan	1.0%
Kamboj	20%
Masute	2%
Mungra	1%
Saini	69%
Total	**100%**

Table 2 clearly depicts that there were seven prevailing castes in the filed area. Among these castes the most dominant castes were Kamboj, Banwait, Harijan, and Saini. The results showed that 69 percent of the respondents said that they belonged to the Saini caste. There were 20 percent of the respondents disclosed that they belonged

to the Kamboj caste. It was also found that 6 percent respondents belong to Banwait and 2 percent belonged to masute caste group. The demographic data showed that 1 percent respondents belonged to Gagian, Harijan and Mungra.

Figure 7: Percentages of castes prevailing in study area

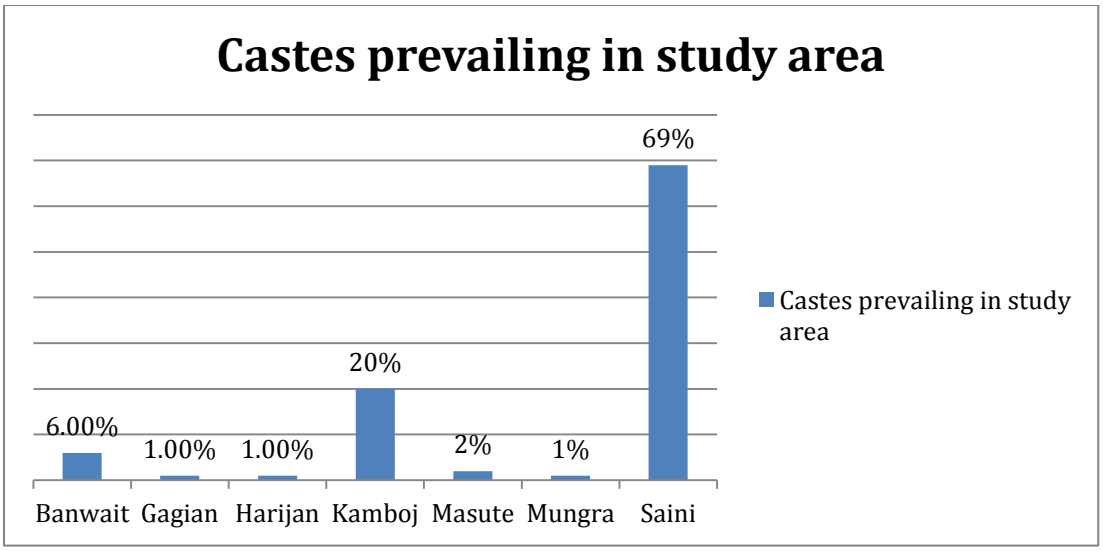
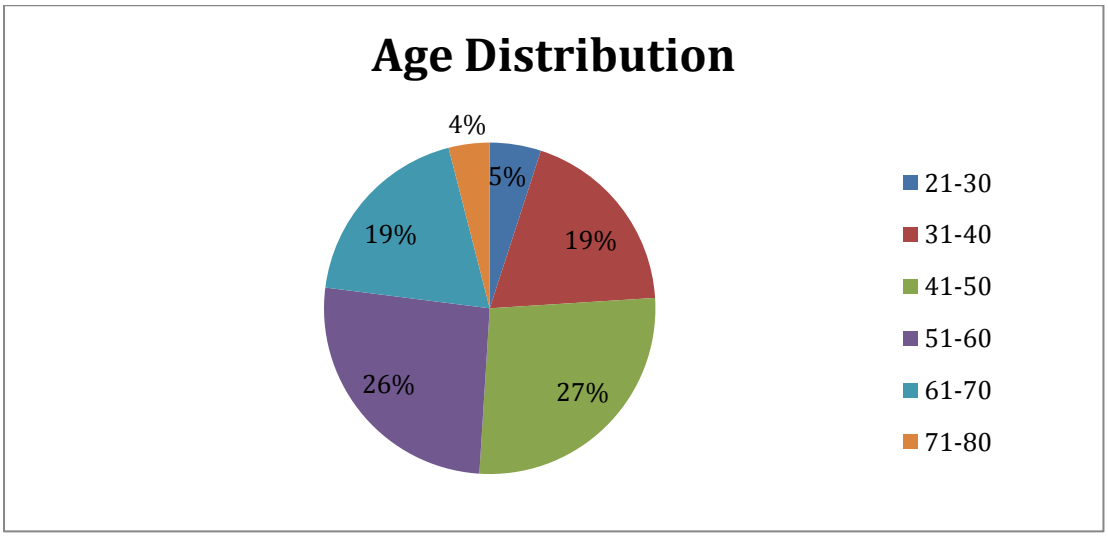


Table 3: Diagrammatic representation of Age distribution

Sr. No.	Age Distribution	Percentage
1	21-30	5
2	31-40	19
3	41-50	27
4	51-60	26
5	61-70	19
6	71-80	4

Age is a chronological number based on the number of months or years since a person's birth. The proportionate number of persons in successive age categories in the given population has been shown in **table 3**. The detailed results show that the maximum percentage (27 percent) of respondents were between age group of 41 to 50 years old. The results also showed that (26 percent) of the respondents were those who belonged to the age group of 51 to 60 years old. Interestingly, it was found that (19 percent) respondents each from the age group 31 to 40 years old and 61 to 70 years old. At last, it was found that (5 percent) respondents belonged to the category of 21 to 30 years old and only (4 percent) respondents were clubbed under the age category of 71 to 80 years old.

Figure 8: Diagrammatic representation of Age distribution



Education is an important aspect of our life, it is the key to success in the future, and brings opportunities to our life. Education has many advantages for people. Not only it luminates a person's mind and thinking but also helps in developing human personality, thoughts, and social skills. During data collection the education level of the respondents was noted down to see how the education has impacted the respondents lives and how much awareness has been created.

Table 4: Education Qualification

Sr. No.	Qualification	Percentage
1	Illiterate	7
2	5^{th}	6
3	8^{th}	21
4	Matric	37
5	12^{th}	25
6	Graduation	4

Educational qualification of the respondents of the studied areas Bhankarpur, Mubarikpur and Mirpur has been shown in **table 4** . The table shows how importance of education makes people have a special status in their own society and whereever they live. Results revealed that the maximum percentage of respondents which counts to (37 percent) were educated up to matric. The second highest percentage which counts to (25 percent) respondents were 12^{th} passed which not only imparted self confidence in them but also leads to numerous advantages in future life. This was

followed by (21 percent) of the respondents who were 8th passed which helped in applying discipline on the mind or a process of character training. The data findings showed that 7 percemt of the respondents were illiterate, which indirectly gives a hint about the major hindrance for the progress of the country. Illiteracy not only makes people unable to function in a written culture but also face unemployment and the conditions of poverty. There were 6 percent respondents who were educated only up to 5th standard. Surprisingly, only (4 percent) were graduates, these respondents fall under the higher education category. The higher education category embraces all the post-secondary education, training and research guidance at university level that are approved as institutions of higher education by the State authorities.

Figure 9: Education Qualification

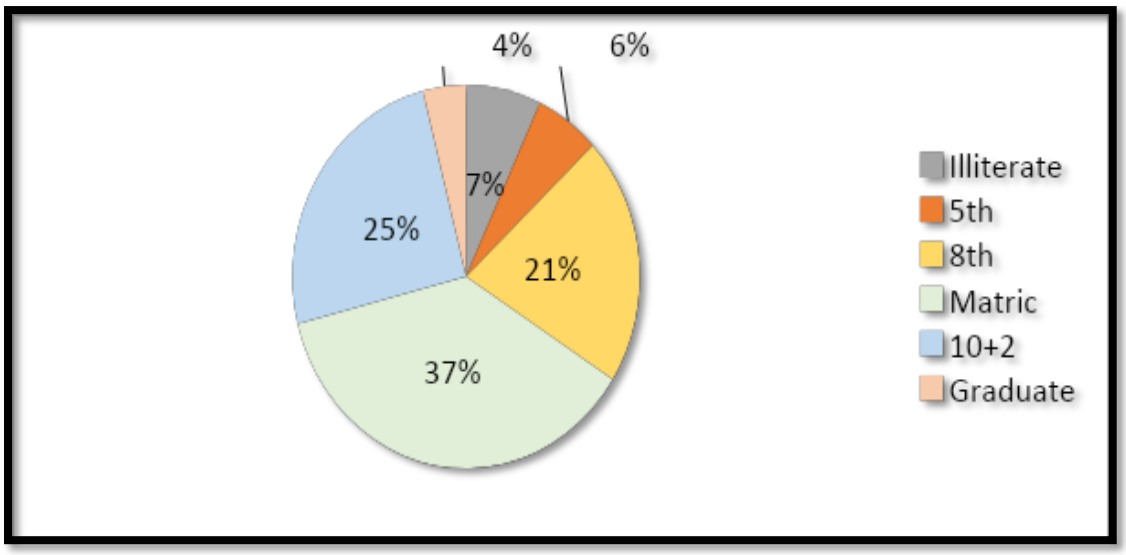
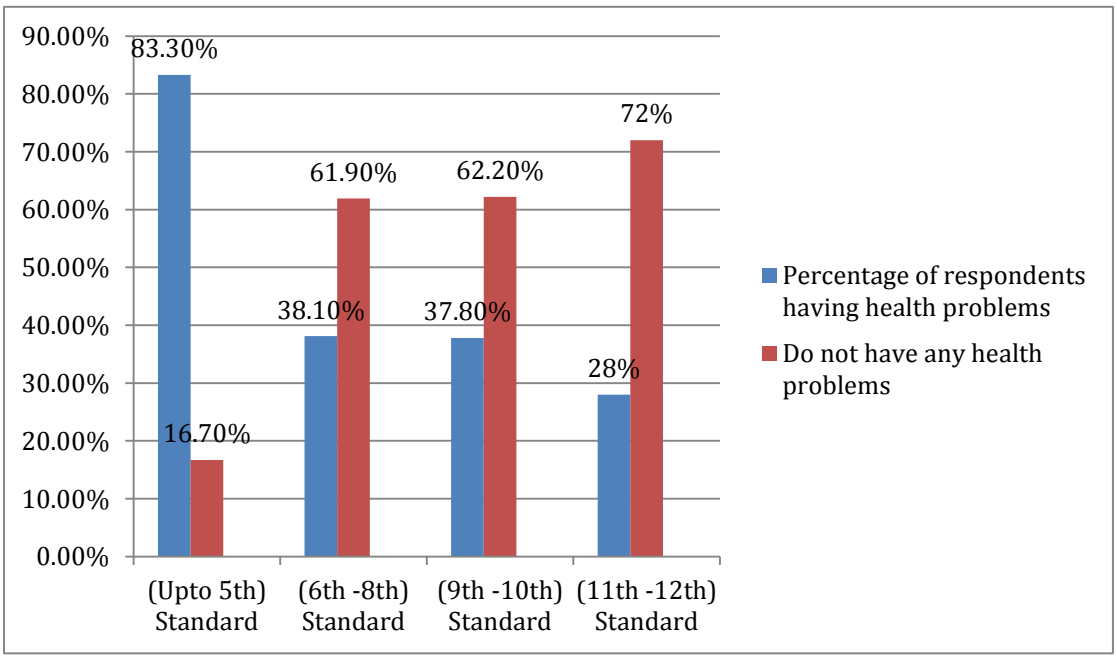


Table 5: Health problems with respect to education level

Education	Percentage of respondents having health problems	Do not have any health problems	Total
(Upto 5th) Standard	83.3%	16.7%	100%
(6th -8th) Standard	38.1%	61.9%	100%
(9th -10th) Standard	37.8%	62.2%	100%
(11th -12th) Standard	28%	72%	100%
Graduation	0%	100%	100%
Illiterate	57.1%	42.9%	100%

Table - 5 depicts that 83.3 percent respondents who have education only up to 5th standards agreed to the fact that they have certain health problems, whereas 16.7 percent said they do not have any health issues. 38.1 percent respondents educated up to (6 to 8 class) experience health problems but also 61.9 percent from the same education group opined they have not experienced any medical issues. There are 37.8 percent of the respondents from age group (9 to 10th) standard said that have several health problems and 62.2 percent from the same age group have no health problems. It was also seen that 28 percent of the respondents were educated upto (11 to 12th) standard. The details about the various medical problems they had faced and are still under medication. Also 72 percent from the same education group did not have any problems. Surprisingly, no one opens up about having any such history of medical problems in their day to day life from people who are graduates, whereas all of them said they have no health issues. There are 57.1 percent respondents who were illiterates and have health problems and on the contrary 42.9 percent may be because of unawareness and most importantly because of illiteracy it was found that they either do not consider minor symptoms as something serious and avoid going to the doctor for treatment. Instead it was found that they believed in natural home remedies and also taking pain killers or other medicines (without consulting a doctors) to obtain instant relief.

Figure 10: Health problems with respect to education level



When looking for a correlation between schooling and wellness, David Cutler et al. (2006) cited similar findings from their literature review and statistical analysis. Income, the job market, and family background variables fail to adequately explain the strong link between education and health that they observe. Better educated people had lower rates of anxiety and depression, fewer reported prior diagnoses of acute or chronic disorders, and lower rates of mortality from the most prevalent acute and chronic diseases, according to their research. Additionally, lesser levels of education are associated with bad health, since there is a correlation between poor health in childhood and poor health as an adult. They draw the conclusion that the correlation between health and education cannot be explained by any one component alone. Despite the fact that those with higher levels of education are generally more knowledgeable about health concerns, it's improbable that disparities in information availability across groups adequately account for the effect of education on health.

Table 6: Health Problems with Respect to Various Age Groups

Age Group	**Number of respondents having Health Problems**	**Do not have any health problems**	Total
(21-30)	40%	60%	100%
(31-40)	31.6%	68.4%	100%
(41-50)	37%	63%	100%
(51-60)	42.3%	57.7%	100%
(61-70)	31.6%	68.4%	100%
(71-80)	75%	25%	100%

The process of ageing, biologically results from the impact of the accumulation of a wide variety of molecular and cellular damage over time. It results in permanent and continuous decrease in physical and mental capacity which ultimately leads to a growing risk of disease finally followed by death. These deviations are neither linear nor stable, and they are only loosely associated with a person's age in years."

Figure 11: Health problems with respect to various age groups

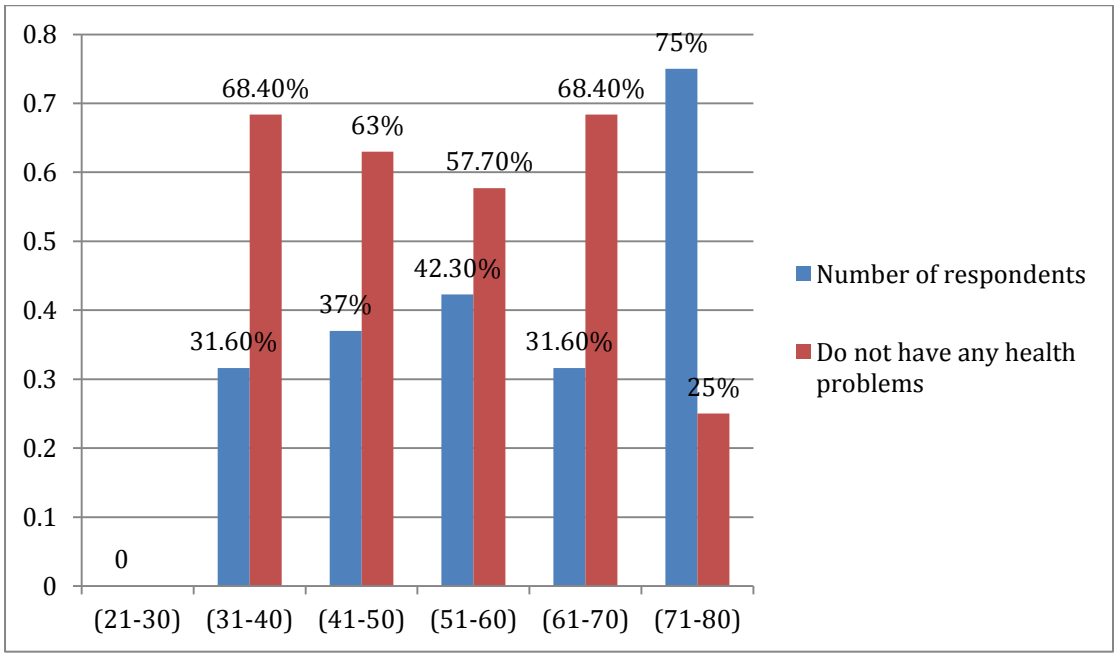


Table 6 showed the association between health problems with respect to age groups. The outcomes revealed that 40 percent respondents from age group (21 to 30 years old) have health problems which included diahorrea, stomach aches, seasonal fevers, and other health problems. Data shows that 60 percent from the same age group i.e., (21 to 30) years of age have no health problems. The results exposed that 31.6 percent of respondents from the 31 to 40 age group agreed to the fact that they experience various health related problems in day to day life whereas, 68.4 percent respondents from the same age group denies any such fact. There were 37 percent of the respondents from age group 41 to 50 years old have several health issues including fever, stomach cramps, diahorrea and most importantly skin diseases due to the use of polluted Ghaggar river water, on the other hand 63 percent says they do not have any health problems and 42.3 percent respondents from the 51 to 60 years age group agreed to the fact that they experience diseases because of the agricultural practices which involved direct or indirect use of the polluted river water, whereas 57.7 percent disagreed to the fact of getting ill frequently. There were 31.6 percent respondents from the aged group of people belonging to (61 to 70) opines that they fall ill very often, on the other hand 68.4 percent from the same age group are opposed to being ill. Lastly, 75 percent from the 71 to 80 years old age groups accept that they have health problems and just 25 percent reported that tells they do not have.

The second objective of the present study was to know the diseases prevailing in the study areas and the factors responsible for such disease. Historically, the word health appeared approximately in the year 1000 A. D. Dolfman (1973) and Balog (1978) studied the roots of the concept of health. Health also included physical, mental, social and spiritual aspects of life. For many years the concept of health was lost under the influence of changing socio-cultural and environmental conditions. From there onwards it was viewed as absence of disease. This particular perception of health still prevails among under-privileged and underdeveloped communities of the world.

Focussing on the present research health related problems were associated with many factors including use of organic methods of farming, inorganic methods, growing commercial crops, non-commercial crops as well and it was also associated with the indirect use of Ghaggar river water. The flowing water of the river not only contains industrial effluents but also was loaded with many contagious viruses and germs which caused numerous number of skin problems to the farmers. Interestingly, very few farmers used the water in their fields but they said they walk through the water to cross the river which brings them in direct contact with the polluted river water. This was supported by many case studies obtained during the interview of the respondents.

Case 1: "One of the respondents from Mirpur village Harnek singh, 40 years jatt sikh, narrates the present scenario of Ghaggar river. "He elaborates how the river has changed during a period of time and details how wild vegetation, Hyacinth, coming from Haryana side led to further blocking of already blocked Ghaggar river resulted in waterlogging all around. According to him, the Punjab Environment Minister Mr. Om Prakash Soni once visited the Ghaggar River near Dera Bassi and directed the officers of the Environment Department and Pollution Control Board (PPCB) to keep a check on the factories in that region to prevent contamination of river water by factory discharges." He adds that the Minister gave them words that the leaking of dangerous factory waste into the water bodies will no longer be seen in Dera Bassi region. He describes that not only did the environment minister promised but also instructed the respective officers that there should be a regular check on industries so that the run-off water should not be thrown into the rivers. He added that if any industry is found violating the laws, strict action would be taken against the particular factory".

Case 2: "During interviewing one of the respondents linked the increased rate of diseases, particularly skin diseases, to the deteriorating water quality. "Though children are born healthy, but fall ill very quickly later on". Many respondents supported this view point and they also revealed that "consuming some crops are threatening the health of the people, like the lentils are safer to be consumed as they are less contaminated". Due to the presence of these pesticide residues in the food, water, air and soil, entire families, communities and buyers are at risk of indirect exposure to toxic pesticides".

Case 3: "According to Harpreet Singh (42 years) Consuming vegetables like cauliflower, okra, and egg plant grown in such soil which is irrigated with polluted water of the river in not at all safe". It's our belief that they are unhealthy for human intake, therefore, we do not eat them. Having said that I would also add that though we do not consume but we sell them to the markets".

Case 4: Similar story was seen in case of one of the respondents who was also a farmer. "The toxic water which was the leftover water after washing the equipment's used for spraying, the empty containers and the unused pesticide solutions, all these were poured into the water channels which was leading towards agricultural fields. Directly or indirectly this toxic water containing pesticide residue were often used by children for playing and by the cattle for drinking purpose. Though numerous camps were already organised in the area but these programmes hardly made any impact on the mind-set of the people to accept the healthy habits regarding the pesticide use".

"The contaminated water of the Ghaggar River was causing a host of difficulties for the locals who lived in the river basin, according to field data. The water from the Ghaggar River was too toxic for human consumption and could not support aquatic life. Both the PPCB reports and the press stories corroborate the current study's conclusions. Additionally, it states that chemical wastes from the industry contaminate the subsoil, an essential layer of soil for agriculture, and that river pollution makes crops vulnerable to harm".

Reportedly, the Central Pollution Control Board found that the discharge of untreated trash through the Baltana Drain downstream of Mubarakpur exacerbates the pollution situation in the Ghaggar River. There is a 57 mg/l BOD concentration and an 822 kg/day BOD load at Baltana Drain. The Raipur Kalan STP, which can process 5

MGD, is fully functioning at the moment. Over 5 MGD of sewage from Punjab, Chandigarh, and Panchkula is treated by it. The Ghaggar River's water quality declines when 5 MGD of untreated sewage is directed to the Baltana Drain. Daily biochemical oxygen demand (BOD) loads of 1,783 kg and concentrations of 14 mg/l indicate that the Ghaggar River, which flows adjacent to Mubarakpur, is severely polluted.

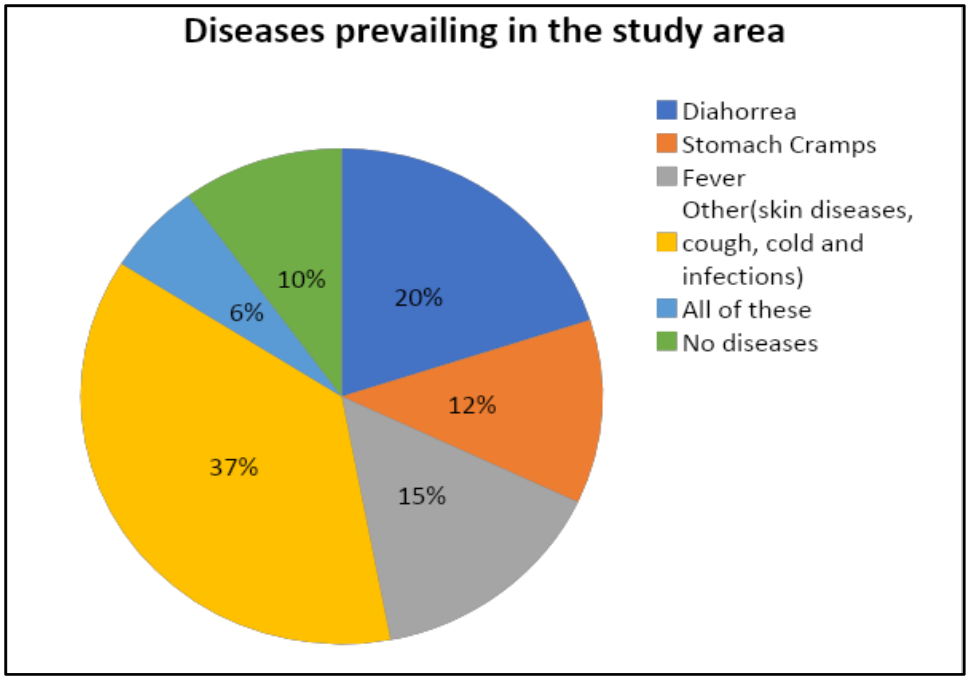
Table 7: Various types of diseases prevailing in study area

Sr. No.	Diseases Prevailing in Study Area	Percentage
1	Diahoria	20
2	Stomach Cramps	12
3	Fever other skin diseases	15
4	Cough, cold and infection	37
5	All of these	6
6	No diseases	10

Figure 7 shows that frequency of various diseases which are prevalent in the study area. It classifies various types of health problems witnessed by the respondents. Data indicated that the incidence of (skin diseases, cough, cold and infections) was highest among the respondents of the studied villages namely Mubarikpur, Bhankarpur and Mirpur which sumsup to 37 percent. The second highest percentage which 20 percent was of diahorrea which is said to be due to viral infection and water borne parasites. Field data also exposed that 15 percent respondents supported the view that they suffer from mild fever, chills, and muscle tiredness these may be linked to stomach infection or gastroenteritis. Some of the respondents shared a sudden, tight feeling in the muscles of your belly, which can be termed as stomach cramp. Only 12 percent disclosed that having such health issues in day to day life can be linked to the impure and non-drinkable water available for drinking purposes.

It can be said that the ground water might have become polluted which in turn is directly poisoning the other water resources. The farmers narrated they come in contact with the water loaded with chemicals from factories while doing agricultural practises resulting in several infections of stomach and skin. While interviewing 16 percent respondents opined they had experienced almost every health diseases mentioned once or even more than once.

Figure 12: Various Types of Diseases Prevalent in the Study Area.



Extended life expectancy is a global phenomenon. Living into one's sixties and beyond is now considered the norm for a majority of people. Both the absolute number and the percentage of people aged 65 and over are on the rise globally. persistent inflammation and a persistent pro-inflammatory state mediate some of the many changes that occur in our immune systems as we become older.

Case 5: Harnek Singh of middle age from Bhankarpur village discloses that "during old days there was good food free from any chemicals and the milk was also pure as during that time the cattle's feed on grasses and plants which were pesticide and insecticide free. Barely, did he hear that people are falling ill and are rushed to the hospital, it is the present time which he mockingly addresses as *kalyug* (bad time) when every household has at least one member either seriously ill or having some chronic diseases".

Case 6: "One more respondent, Gurbachan, 80 years old, shared similar view point saying the world is coming to an end because of which there is a lot of death incidences due to several diseases. The world is full of crimes everywhere, there are more number of sinners than good people. This is the only reason why god is not happy with us and taking away our loved ones one by one".

Case 7: A respondent describes the use of pesticides according to the type of crop cultivated. He narrates that "they usually work for long hours as long as eight to nine hours or even more, a day to continue every activity carried out in agricultural fields including spraying of pesticides. During the spraying schedules neither do they take alternate breaks nor any protective measures like using proper clothes, hand gloves, goggles and also a mask. On interviewing it was found that the farmers carried pumps at their back filled with chemicals which might leak on their clothes during the spraying process. Not only that, the exposure of pesticides was also encountered during the opening of the bottles, mixing the chemicals with naked hands. Education does play a vital role in such scenario, as the respondents believed that washing hands with simple water cleans their hands and makes their body pesticide free, irrespective of the fact that these harsh chemicals are directly absorbed into the skin once it is touched or inhaled".

Case 8: Another respondent while interviewing was asked about the process of pesticide storage, it was an attempt to check the awareness of pesticide toxicity among the respondents. It was found that "there was no protective measure taken to store the pesticides and the empty containers containing pesticides. Though, they agreed that they never keep pesticides in close proximity to the eatables but it was not accurate information. This lack of knowledge can be harmful for the residents".

The relationship between health and education has long been attempted to be related. It has been extensively studied for a wide range of health metrics in numerous countries and eras. The correlation between the number of respondents who reported having health issues and the different age groups is diagrammatically represented in the table.

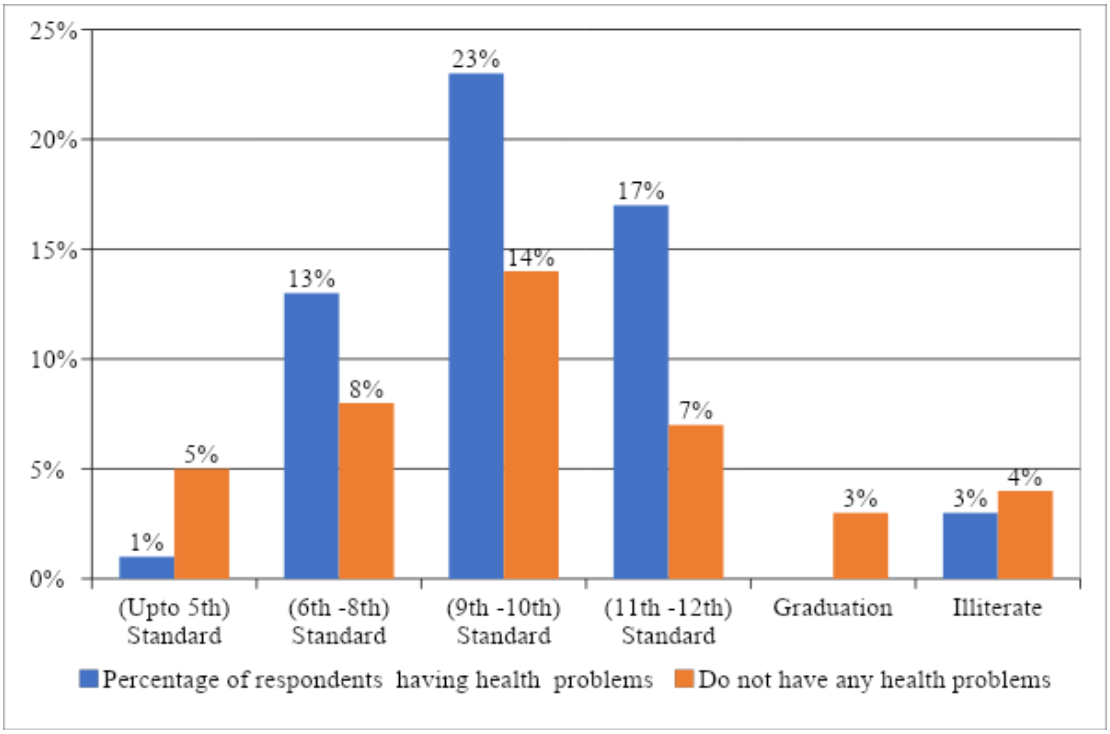
The **table 8** clearly shows that 40 percent of respondents who fall under age group (21 to 30) disclose that they have no health problems, whereas 20 percent of the respondents report that they experienced both diahorrea and stomach cramp. It can be said that the cramps are directly related to diahorrea, where instances of loose bowel increases leading to loss of body fluids. Further, it was found out that 35.3 percent respondents belonging to (31 to 40) age group denied of having experiencing any health related problems. It was followed by 17.6 percent respondents complaining about stomach cramps, 5.9 percent about fever, 5.9 percent said they are having fever with stomach cramp, and 35.3 percent respondents indicating many other diseases and illnesses.

Table 8: Health problems of respondents within different age groups

Age Group	Health condition									Total
	Nothing		Diahorrea	Stomach Cramps	Fever	other	All	Diahorrea and Cramp	Cramp and Fever	
21-30		2	0	0	0	2	0	1	0	5
	% within Age	40.0%	0.0%	0.0%	0.0%	40.0%	0.0%	20.0%	0.0%	100.0%
	% within Health condition	5.3%	0.0%	0.0%	0.0%	5.4%	0.0%	33.3%	0.0%	5.1%
31-40	Count	6	0	3	1	6	0	0	1	17
	% within Age	35.3%	0.0%	17.6%	5.9%	35.3%	0.0%	0.0%	5.9%	100.0%
	% within Health condition	15.8%	0.0%	42.9%	16.7%	16.2%	0.0%	0.0%	100.0%	17.3%
41-50	Count	10	2	1	1	10	2	1	0	27
	% within Age	37.0%	7.4%	3.7%	3.7%	37.0%	7.4%	3.7%	0.0%	100.0%
	% within Health condition	26.3%	100.0%	14.3%	16.7%	27.0%	50.0%	33.3%	0.0%	27.6%
51-60	Count	11	0	2	3	8	2	0	0	26
	% within Age	42.3%	0.0%	7.7%	11.5%	30.8%	7.7%	0.0%	0.0%	100.0%
	% within Health condition	28.9%	0.0%	28.6%	50.0%	21.6%	50.0%	0.0%	0.0%	26.5%
61-70	Count	6	0	1	1	10	0	1	0	19
	% within Age	31.6%	0.0%	5.3%	5.3%	52.6%	0.0%	5.3%	0.0%	100.0%
	% within Health condition	15.8%	0.0%	14.3%	16.7%	27.0%	0.0%	33.3%	0.0%	19.4%
71-80	Count	3	0	0	0	1	0	0	0	4
	% within Age	75.0%	0.0%	0.0%	0.0%	25.0%	0.0%	0.0%	0.0%	100.0%
	% within Health condition	7.9%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%	4.1%
Total	Count	38	2	7	6	37	4	3	1	98
	% within Age	38.8%	2.0%	7.1%	6.1%	37.8%	4.1%	3.1%	1.0%	100.0%
	% within Health condition	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Respondents falling under (41 to 50) age group, 37 percent said they have no problem. 7.4 percent people of the studied village opine they have diahorrea, 3.7 percent each has stomach cramps, fever, diahorrea and cramps respectively. There were 37 percent respondents who were those who had other health issues which are not mentioned in the Performa. It was seen that 7.4 percent were such who had experienced every mentioned health problem at some point of time. 42.3 percent respondents who fall under (51 to 60) age group individual discusses having no health related problems. There are 7.7 percent respondents were such who had stomach cramps and also who had gone through all diseases and health issues which were mentioned in the interview schedule respectively. Also 11.5 percent respondents complained about having fever followed by 30.8% respondents having some other difficulties.

Figure 13: Health problems with respect to education level



There are 31.6 percent respondents who belonged to (61 to 70) age group narrates about having no health related problems. 5.3 percent discloses respectively about having stomach pain and fever. 52.6 percent had other problems in their day to day life. 5.3 percent said they are suffering from diahorrea and stomach cramps very often. 75 percent respondents belonging to category (71 to 80) claims themselves as

fit, though they belong to that age group who are the senior citizens and are most likely to have one or two health problems but surprisingly, the results are just opposite. It might be said that because of the good and healthy diets and health practices that our ancestors used to follow made them fit and fine even at old age. It can also be said that they being physically and mentally strong might ignore petty and minor issues related to health. There were 25 percent respondents who belonged to the aged group said they sometimes feel unwell because of many little and in-consistent problems.

Figure 13 clearly shows the association between Health problems with respect to the education level of the respondents. Education plays a vital role in building the character of an individual. It helps to aware every individual about the types of health issues and the probable causes. It figure shows that out of 6 percent respondents who have education till 5^{th} standard, 1 percent agreed of having health problems whereas 5% had no health related issues. 13 percent respondents out of 21 percent of respondents who had education from 6^{th} to 8^{th} standard tells that they had health problems whereas 8 percent tells that they have no such problems related to health. There are 23 percent of respondents out of 37 percent who completed their studies from 9^{th} to 10^{th} standard had agreed to the fact that they are facing health problems whereas, 14 percent said they are perfectly fine with no complaints of any such health issues. The data clearly shows that 18 percent out of 25 percent of the respondents who studied till 12^{th} standard has many health related problems which includes skin diseases, cough and cold and many others, on the other hand 7 percent out of these 25 percent disagree to the fact. It was surprising to note that only 4 percent of the respondents from the field area are those who are graduates and these 4 percent also falls under the category of those who are facing illness. Lastly, 7 percent respondents from the field area were found illiterates out of which 3 percent have health problems and 4% have no problems. Many studies supported this view point as their results revealed negative health effects of pesticide, misused it. As a result, both acute and chronic cases of pesticide-induced illness were common in the area.

Lah (2011) and the World Health Organisation both agree that even very low levels of exposure throughout a person's development might have harmful effects on their health (2015). Results from their studies were same. An estimated 220,000 people die

each year from pesticide poisoning, with 3 million of those cases happening in developing countries, according to the World Health Organisation. Pesticide treatments aren't always accurate, which could lead to unwanted exposures to other species. Toxic effects of pesticides are magnified in developing and juvenile creatures.

Also, in the Rincón the Santa Maria region, Dabady and Tulk (2015) set out to investigate how people there see, understand, and actually use pesticides. This was further supplemented by raising farm workers' consciousness about the potential negative impacts of these toxic compounds on human health. The findings showed that pesticide poisonings in Panama are associated with many disorders.

Case 9: Respondent from Mubarikpur village namely Gurjeet Singh, 49 years, a Jatt Sikh, depicts a clear picture of the River Ghaggar and its poor quality due to water pollution. He narrates about the "health problems prevailing in the field area among the farmers specially during monsoon. He describes how the water loaded with harmful chemicals from the factories when comes in contact with the skin causes skin rashes, fungal and bacterial infections and also blisters in rare cases. About the visit of the environment Minister of Punjab in the region along Ghaggar river he says that the minister would not leave any stone unturned to make the environment of the state green and clean. He also says that the required steps to be taken very soon. According to him, it is the responsibility of the industrialists not to throw contaminated water and other industrial residues in the rivers".

Case 10: Another respondent from Mubarikpur village, a middle-aged farmer (30 years) also narrated on the health problems which are experienced due to the use of insecticides. He narrates that "there is no such good yield in organic farming so very less number of farmers opt for such farming methods, he added that the only source of income is through farming only if they do not get good yield they will not be able to carry all the expenses of not only the family but also the expenses required for buying seeds, pesticides and insecticides, the cost of sowing and ploughing the land for the next crop is not met".

Case 11: Gurdiyal Singh 50 years narrates "Angrezi spray mitti ch pah dende ah, gahan nu wadia fasal awe, spray nal allergy di problem andi te pinda uth khad janda ah, spray kaye wari charh v jandi ah, dactari ilaj karwana painda…nuksan ho janda ah…fasal wadhan laye spray poni paindi ah…. Faida kuch ni par apa kariye ki apa majbur ah.."

Translation: "We are helpless, we are bound to use pesticides and insecticides in our crops to get good yield, with the use of these harmful chemicals multiple health problems arises including skin allergies, fever and also sometimes it causes breathing difficulty during spraying… At times we have to consult a doctor. A good harvest is what we expect at the end in spite of knowing the pros and cons of pesticide use... we have no other option left ….."

This study's results and examples were consistent with those of Aktar et al. (2009). He claims that pesticides have the potential to harm other forms of life and other ecosystem components, such as air, soil, and water, due to their poisonous nature and targeting certain groups of species.

The third objective of the current research was to study the awareness and acceptance of organic farming among the population in the study areas.

Case 12: Sewa Singh 49 years of age tells that very few farmers are aware of organic farming**.** Even if they are made familiar about its benefits the availability of seeds is a big problem for them. Neither the quality of seeds are easily available nor it is cheaper to be afforded by every farmer. Secondly, there are only few *mandis* (markets where crops are sold by the farmers to the third persons) which are exclusively meant for organic fruits or vegetables. Sometimes the farmers do not get buyers and also worthy price for their crops. Farmers are supposed to sell their organic crops only in these mandis only.

Case 13: According to one respondent, "learning about organic farming was the hardest thing for farmers. People still believe in chemical fertilizers, especially for disease control and seed development, therefore it's important to raise awareness about organic farming", he said. He elaborates by saying that organic farmers are familiar with practices such as seed rotation, weed control, green manure made by hand, animal manure, plant and kitchen waste, and so on.

Case 14: When asked about farmers' familiarity with and support for organic farming, one responder offered an alternative viewpoint. He claims that "in order to address the information demand of a marginal farmer, the government should launch campaigns. Better results may be achieved if the government took the initiative to educate farmers on the importance of soil, plants, and organic compost. Government entities concerned with agriculture should spearhead extension initiatives and promotional activities to educate peasants about landscapes, improved crops, modern farming techniques, and effective governance systems for organic farming".

Table 9: Various Types of Crops Grown in Field Area

Crops types	**Percentage**
Potato, Rice and Sunflower	5%
Potato and Rice	5%
Rice ,Potato, Wheat, and Onion	55%
Rice and Wheat	18%
Vegetables	5%
Fodder	2%
Rice, and Wheat	6%
Rice, Wheat, and Vegetables	1%
Rice, Wheat, and Fodder	3%
TOTAL	**100%**

Table 9 shows that the frequency of various types of crops grown in the field area by the farmers. The crops grown mainly in the area includes rice, wheat, sunflower, and vegetables like potato, onion and tomato. Some also grow fodder for the cattle. Data from the field showed that 55 percent of the respondents when interviewed unveiled that rice, potato, wheat, and onion are the main crops grown in their field. There are 18 percent respondents who cultivated only rice and wheat in their field. 5 percent respondents each said that they grow Potato, Rice and vegetables respectively. 6 percent respondents opined they cultivated only rice and wheat in their field. 3 percent farmer respondents were such who grow Rice, Wheat, and Fodder. 2 percent farmers

only grow fodder for their cattle's. Some of the fodder types includes maize, corn and hay. Dry fodder which is the residue of wheat crop is also used by the farmers. Very few 1 percent grow Rice, Wheat, and Vegetables in their fields.

Results revealed 68.7 percent respondents said that organic farming is a good practise for the environment, as it avoids and excludes the use of synthetic inputs such as (pesticides, fertilizers, hormones etc) and it relies on crop rotation, crop residues and animal manure. 31.3 percent respondents were quite as they hardly knew or had any knowledge about organic farming.

Figure 14: Co-relation between inorganic farming and health conditions.

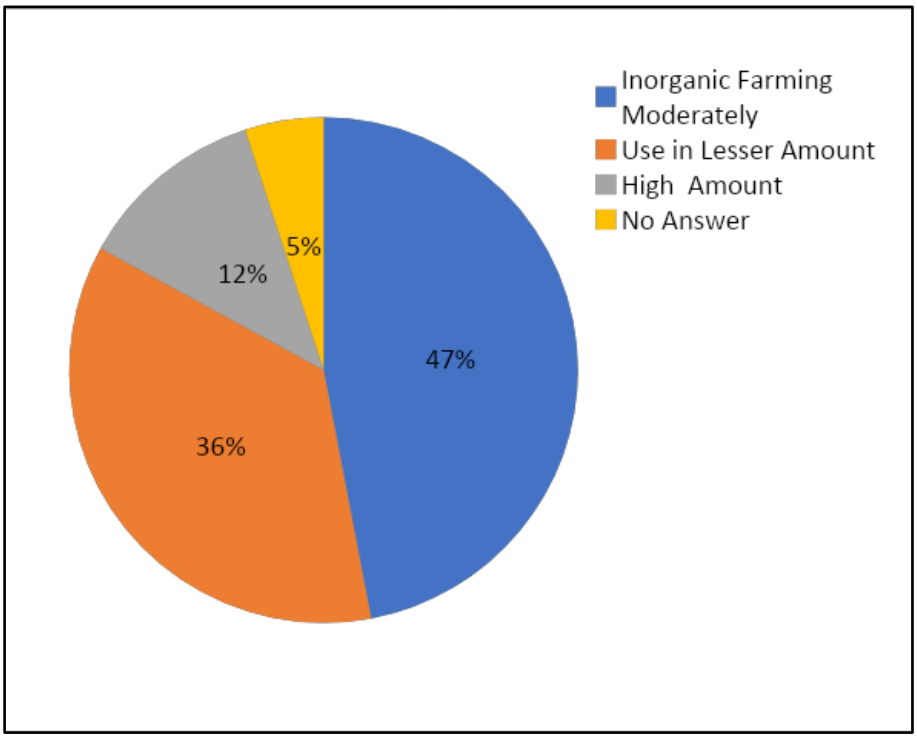
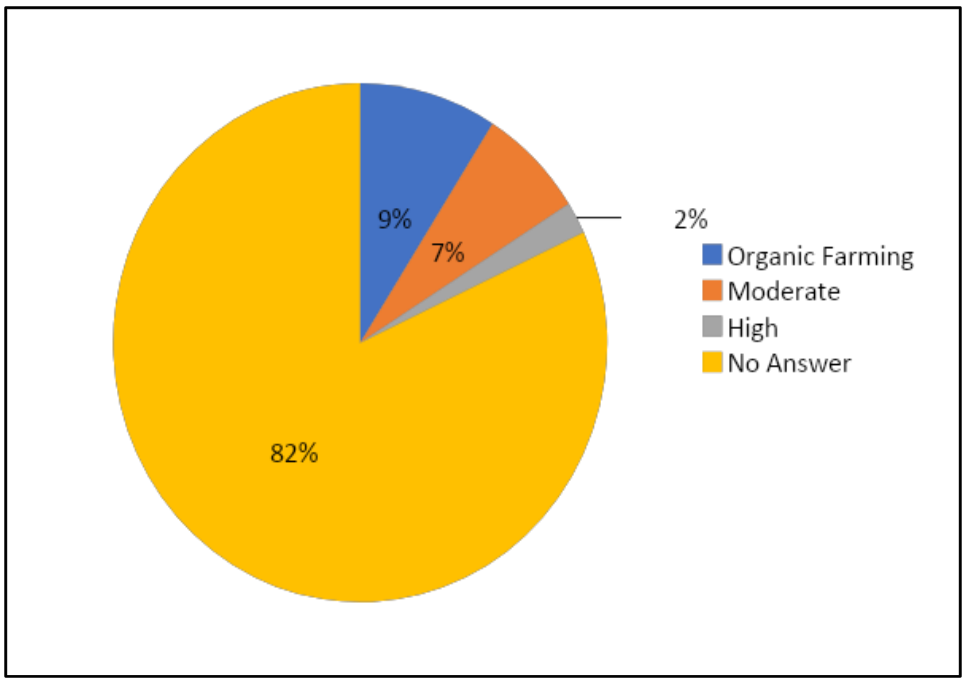


Diagram 14 shows that the respondents who agreed to use inorganic method of plants cultivation in lesser percentages is 36 percent out of which (15 percent has no health problem and only 21 percent has experienced health problems). Further, 47 percent are those who indulge in inorganic farming in moderation. Out of these 47 percent and 25 percent are those who has health problems and 22 percent are those who has no such issues. Lastly, 12 percent open up about saying that they use higher extent of inorganic methods for farming in their fields out of which 11 percent agreed with having health problems and only 1 percent said they do not face any problem.

Figure 15: Co-relation between Organic farming and health conditions



The above figure depicts that 9 percent of the respondents are those who use organic methods of farming in lesser frequency and out of these 9 percent respondents using organic farming method 5 percent respondents said they faced problems related to health and 4 percent said they do not have any. There were 7 percent respondents as shown in the figure use organic methods of farming in moderation and out of these who use organic farming in a balanced manner 3 percent said they have health problems and 4% have no such problems. Lastly, 2 percent respondents were those who used higher levels of organic methods during cultivations also said that only 1 percent had health problems and also again 1 percent did not.

Case 15: Prabhjot Singh from Mubarikpur village, 39 years of age, gives an account on organic farming. He opines that "there are many reasons behind organic farming not catching up with the ordinary farming". According to him there is lack of awareness among the farmers about What Organic Farming actually is? He adds that this particular method of farming is not just a method of production. It consist of a detailing of the knowledge of healthy soil, animals, communities, farms, farmers, plants.

Case 16: Dev Singh 36 years narrates that there are, "Many small-scale organic farmers farm working in segregation. It has been seen that they do not get much

benefits from those communities who supports non-organic farmers. He predicted about future of organic farming , how it should be handled for better results. There is a need for developing storing, processing and marketing facilities so that products reach their markets meeting the quality to ensure standard requirements".

Case 17: Naik Singh from Bhankarpur village (45 years of age) also shares his views on organic farming. He describes that the concept of organic farming is contemporary and it has a long way to reach every household. People are not ready to come out of their comfort zone and adopt change so easily. They prefer sticking on to the traditional method of farming which has been used from centuries till now. Having said that he added that the petty amount of profit and loss from selling the crops does hardly matters for the rich farmers who have large acres of land. The loss or profit gets usually compensated from the other crop growing lands that they own, as they do not depend on only one crop or one agricultural land. But the small land owning farmers suffering loss has an impact on their finances. He also added, that organic farming is not easy method it has a number of do's and don'ts due to which farmers do not opt for this type of farming.

Transformed from mature ovules, seeds are the end product of sexual reproduction in plants. Some plants do not have seeds at all, but the ones that do usually use them to spread their genes from one generation to the next. The ecological and economic value of seeds is enormous. They are beneficial to a plant's early development because of the abundance of protein, carbohydrates, and oil they contain. Many grains and legumes rely on these reserves as a primary source of nutrition for a significant section of the global population.

There were 87% respondents who grew crops for commercial purposes whereas 17% cultivated food crops for personal use only. **The fourth objective was to** review the impact of agriculture on human health. The majority of Punjabis work in agriculture. The State was at the forefront of the Green Revolution and continues to play a pivotal role in the nation's grain supply. In 2011–2012, it supplied 38.50% of the wheat and 22.10% of the rice for the central pool. Wheat had a productivity of 50.97 qtls/ha, while rice had a productivity of 37.41 qtls/ha in 2011–12. More than 58 percent of India's population relies on agriculture for their livelihood, and the sector accounts for around 14.6 percent of the country's GDP.

Agriculture has been observed to have a deleterious effect on both surface and groundwater. Wastewater and contaminated groundwater, on the other side, have a detrimental impact on farming. Fast population increase and urbanization, rising food demand, and severely diminished supplies of clean water all come together to make it quite clear why farmers are turning to wastewater to produce their crops.

In the present study, the agricultural fields in villages Bhankarpur, Mirpur and Mubarikpur (study areas) use polluted water of Ghaggar river for irrigation purposes. Health problems like diahorrea, bloody stools, stomach cramps, vomiting, fever and many other.

The yield of crops is generally disturbed by a multiple number of factors which includes the various plant diseases which destroys the plant completely hitting the yield badly.

Figure 16: Factors responsible behind crops yield

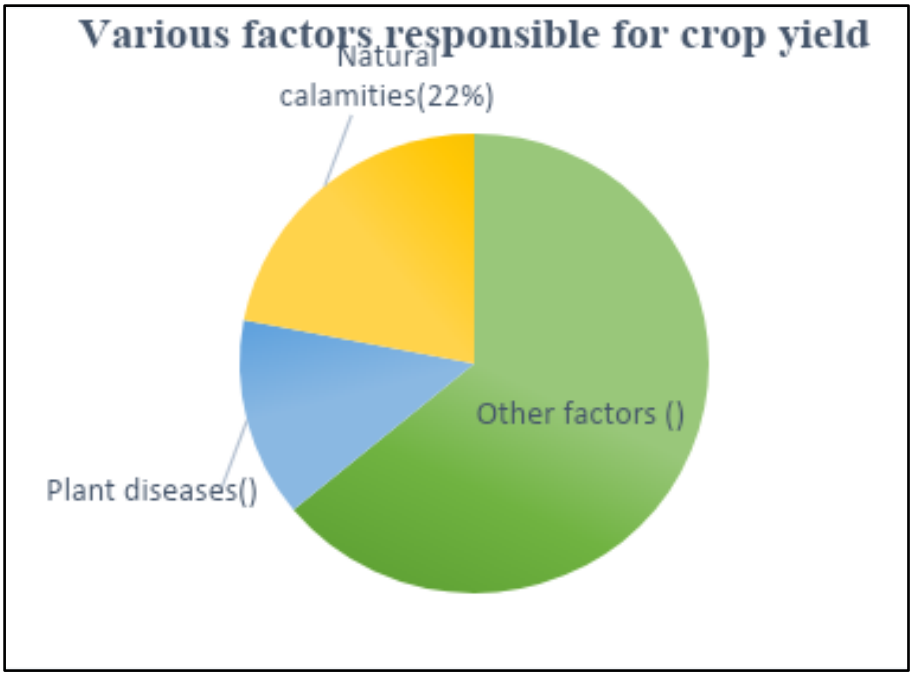


Figure 16 shows that 64 percent of respondents supported that other factors are responsible for the yield of crops. These other factors includes not getting sufficient amount of good quality manures and other transportation facilities required for agricultural practices. It also includes stray animals destroying the crop fields. 14

percent respondents said plant diseases has a direct impact on the yield whereas, 22 percent respondents supported the view point that natural calamities like untimely rain, foggy weather, hailstorms causes poor yield due to damage of pods for a prolonged time period causes the death of the entire plants due to freezing of stem and the fruits. This also hampers the yield of the crop severely since these buds in future gives rise to fruits and flowers in the plant. Other major factors affecting the crop yield include all types of natural calamities like untimely rain, during summers and fog during winters. Similar problems were faced by the farmers of the study areas.

Similarly, Boyer (1982) concluded that climate change was caused by global warming in his research. Climate change and extreme precipitation have severe impacts on plant growth and agricultural output, reducing yields by as much as 70 percent and having far-reaching social and economic consequences.

Stray animals include dogs and calves that have wandered off without their owners and ended up in public areas. These creatures often roam aimlessly without any place to call home. According to the Punjab Government of India[3] domestic animals maintained by religious organizations such as temples or *gaushalas* are not regarded as stray livestock.

The increasing stray animal population is a major societal issue in Punjabi cities due to the fast pace of urbanization and industrialization. Furthermore, farmers have a major issue when these animals provide a continual danger to crops grown throughout the year, as a consequence of the depletion of food supplies caused by the careless expansion of perennial blooming plants and summer forest fires. Many different kinds of crop-raiding, livestock predation, human injury or death, and other types of human-animal conflict fall under the category of competition and predation (Knight, 2000). As narrated by some of the respondents:

Case 18: Sukha Singh (48 years of age) from Mubarikpur village with a low tone recalls how every time in spite of all the measures taken to keep the abandoned animals away from the fields they fail to do so. These stray cow's and buffaloes run amok which force the farmers to come out during the day or night to protect their

[3] (http://pashudhanharyana.gov.in),

crops from being destroyed. He also tells that though there are *gaushala* (cowshed) in the area , but still these animals move around and destroy the crops.

Case 19: During a group discussion with farmers each one of them had similar stories on stray animals. According to them, "crop damages and extent of losses depends on the population of animals (wild & stray cattle) prevalent in the locality. Their population might increase or decrease in a particular area. Farmers tells that the cow is considered clever animal, if gets to know the crop field, the animal repetitively comes to the same crop field to eat the crop and damage it as well."

Case 20: Some respondents opined that not only cows or buffaloes but also wild boars damages the crop fields. These boars runs very fast and they dig the soil and eat the germinating seed thus, ruining the whole field. Also he adds that big animals like cows are kept away by putting barbed wired fencing but keeping wild pigs away becomes a very difficult tasks for the farmers. The farmers are unsuccessful in protecting their farmlands from these animals even after trying multiple number of ways.

Case 21: Stray animals have devastated farmers' livelihoods, according to Hardiyal Singh, 55 years old. Raising the fence becomes almost difficult due to the high expense of fencing. Additionally, he reveals that city dwellers sometimes release their unproductive cattle onto the streets, where they threaten the safety of commuters, especially at night when the animals are hard to see. Community disputes, on the other hand, result from releasing the worthless animals into the village side. As a result of the widespread use of machinery, farmers have also begun to forego the use of bulls, which were once used to pull carts and plow fields.

Case 22: One of the residents who is also a farmer discloses a shocking revelation that not the stray animals are creating problems by destroying our crops but also the very often one can hear cases of dog bites and cow/bull attacks. He added that these incidences are also published in print media which caused a sensation. Many children are bitten by stray dogs with serious injuries. Not only this, he also gives the reason behind the increasing number of stray dogs in the area. Dogs who are scavengers develop territorial habitats, for survival they find easily available food for them in garbage dumps. Besides, many residents feed dogs at their door steps.

Similar results were obtained by Mehta et al. (2018) when they investigated the impact of stray and wild animals on crops. When animals forage in agricultural fields, the research shows that this causes crop damage. Due to crop raided by wild animals, the household income of the agricultural community has dropped significantly. The results show that farmers are in agreement that crop raiding by wild animals reduces production quantity, while some respondents are in agreement that crop damage by wild animals reduces product quality, leading to poor market prices for farmers.

Thakur et al. (2022) also found that monkeys, wild boars, and nilgai stray cattle were the most common animals that caused damage to crops. The issue is more recent in comparison to animals in nature. When contrasted with the problem of feral animals, the issue of stray cattle is more recent. Once a week, strays and wild animals would ravage crops. Wild animal menace was the most pressing problem in the research region, according to half of the respondents who rated it as high, compared to stray cattle menace, which was rated as medium.

Pesticides disrupt the vital biological processes of both pests and other forms of life. Crops and field products are never exclusive to a single species; in fact, they are eaten by all Homo sapiens. While pesticides are effective in killing pests, they may cause damage to humans who come into contact with them via inhalation, pesticide residue in food or drink, or even through their work or household tasks. The problem with using pesticides is that they could end up harming or killing other creatures, some of which are helpful and others of which aren't. The perfect pesticide would have a short half-life, be able to selectively kill the target organism, and then break down into harmless, inert substances when released into the environment.

The different insecticides are listed in Table 7 according to the pest they target. There are several different chemical families that pesticides belong to. Some notable families of insecticides include carbamates, organophosphates, and organochlorines. It is possible to segregate organochlorine hydrocarbons (such as DDT) into cyclodiene compounds, dichlorodiphenylethanes, and other similar chemicals (Kamrin, 1997). Carbamates and organophosphates have mostly supplanted organochlorines because of their ability to inhibit acetylcholinesterase. Because of their high toxicity to vertebrates, carbamates have largely supplanted organophosphates in several situations (Kamrin, 1997). Thiocarbamates and

dithiocarbamates are the two subclasses of carbamates. Benzoic acid and phenoxy are two prominent herbicide families.

Table 10: Provides classification of pesticides based on target pest

PESTICIDE TYPE	PEST
Algicide	Algae
Avicide	Bird
Bactericide	Bacteria
Fungicide	Fungi
Herbicide	Weeds
Insecticide	Insects
Miticide	Mites
Molluscicide	Snails,Slugs
Nematicide	Nematodes
Piscicide	Fish
Rodenticide	Rodents

Source: Mahmood et al., 2016.

A resident of Bhankarpur village narrates the problems which are faced during farming.

Case 23: Baljeet singh aged 42 years from Mirpur details about the reasons for poor crop yields as faced by the farmers. According to him "climate change has a major impact on the crop yield these days. Uncertain rainfalls and also variations in climate has caused a change in the quality and quantity of crop yields. The seeds are sown but the abrupt rainfall i.e., shifting of monsoon months has hampered the output of the crops. For example, during wheat cultivation rainfall during germination period damages the seed, leading to poor quality of seed, "*daane da macchh mar janda"* (killing the life of the seed).

Case 24: Harjeet Singh aged 39 years from Bhankarpur villages details about how farming is effected due to climate change. "The change in rainfall pattern has impacted the yield very much. The seeds are sown during the propagating time but

when in one hand some places experience heavy rainfall, on the other hand few places face no rainfall".

Case 25: One more respondent describes the problems faced during potato cultivation. He tells that "during potato germination if it rains heavy, then water logging problem arises which in turn causes rotting of the potatoes. The farmers then had to remove all the rotten potatoes from the field so that it can be prepared for the next crop cultivation. This whole process requires a good amount of money right from sowing of seed to removing the rotten crops to ploughing the field for the next crop cultivation".

Similar problems encountered by farmers have been detailed in several papers written by a wide range of academics and writers. According to the results published by the Reserve Bank of India (2020), weather-related variables still significantly affect India's crop yields. The loss of agricultural output in India is being threatened by climate change, which is characterized by rising temperatures and more frequent severe weather events. Factors that reduce agricultural productivity are also discussed in detail in Raza et al. (2019).

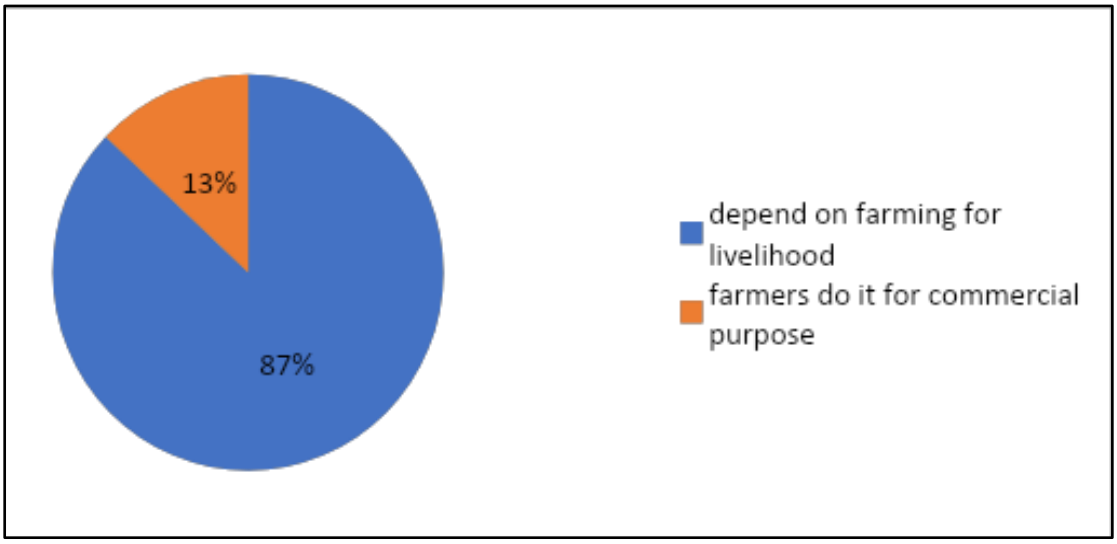
Crop yields are affected by climate change in a direct way by changes in yearly rainfall, average temperature, the amount of carbon dioxide in the atmosphere, and variations in sea levels. He predicts that, over the next few decades, a variety of agricultural pursuits will be severely impacted by variations in rainfall and temperature. Climate change is posing a growing threat to agricultural production due to the frequency and severity of severe weather events that cause significant crop output losses. As was evident in the post-Covid era, a shortage of labor or human resources may also be a major obstacle that negatively impacts production.

The last and fifth objective of the present research was to comprehend the link between health and socio-cultural change.

A person's health is influenced by a number of factors, such as lifestyle decisions, genetics, access to adequate healthcare, and environmental factors like housing, water, and air. The financial status of farmers may have an impact on their overall health. Because of their existing debt load, the borrower may be less likely to make decisions that will maximise their health, and they may need to put in longer hours to make their debt payments, which increases their stress levels anyway.

India sells a large portion of its agricultural surplus and grain to other countries. The modern commercial operation of agriculture supplies nourishment for everyone who works the land, including the farmer's family. The majority of people believe that the simplest way to feed a family is through farming. In India, agriculture is more of a culture than a business strategy. It is a lifestyle.

Figure 17: Farming as a source of livelihood



Respondents chosen for the present study were solely farmers who are directly or indirectly dependent on farming for their livelihood. Figure 17 is a pictorial description of the percentage of residents who depend only on farming and agricultural practices as their mode of living which leads to a huge number i.e., 87 percent. These 87 percent people from the field were those gain livelihoods through production on their pieces of land. Data also revealed that 13 percent were those who had some other sources of earning apart from farming. These other sources includes small businesses, grocery stores in the village itself or nearby town. Their source of income for earning their livelihood is from holding into petty businesses which includes departmental store, chemist shop (with only limited medicines), some were also auto-rickshaw drivers and so on. Some of the villagers were also money lenders, they used to lend money to others. During the interviews it was found that many people were under debt due to not able to pay the ransom amount on time.

A major problem in India's current agricultural situation is farmers' indebtedness. It is widely recognized as a significant obstacle to rural success. In addition to worsening

socioeconomic inequality, it reduces agricultural yield. Agrarian economies are particularly vulnerable to farmer indebtedness, as discussed in depth by GoI (2007) in his study.

Field data showed that 30 percent farmers revealed that they had no debts, it also depicts their socio-economic conditions, they were financially sound and could fund their farming and agricultural activities at their own, without taking any third party help. These expenses include transportation, ploughing of cultivated land using tractor wheels, also it includes drilling method in wheat production method where seed is sown by seed drill. With the help of this implement seed drop at depth and results in uniform germination and regular stand. Apart from above mentioned expenses money is also used during the cutting period of the ripened plants. Brief narrations by farmers on loans and indebtedness are outlined as below:

Case 26: Gurjinder Singh a farmer (38 years) from the village Mirpur explains the conditions when a farmer is bound to take loans and how they manage the agricultural expenses. He details that the loans are given by banks and sometimes by *Arhtiyas* (middlemen) at interest rate higher than the bank due to immediate need of money for buying seeds, manures, agricultural equipment's and also for family emergencies. The farmer becomes helpless, irrespective of the fact that there is no particular income because of uncertainty in crop yield and profits the amount of interest has to be paid each month. This process continues again and again repeatedly and finally, he commits suicide when he is left with no other way.

Case 27: One of the respondent revealed a very interesting story, which says that he being a Punjabi and has learnt and studied the language from childhood. On further interviewing he reveals that the official language of the state of Punjab is Punjabi, which is written in the Gurmukhi script. Hindi is spoken by very lesser amount of the population. The pesticides had only Punjabi language on the label written in small text font on the pesticide bottles which makes it difficult for the farmers to translate the meaning. The users who were the Punjabi speaking population were unable to understand the written health warnings on labels and leaflets. The respondent added that there are farmers who are illiterates, in that case it becomes impossible for them to learn and make themselves aware about the dosage of pesticides and its impact on human health.

Case 28: Similar story was narrated by one of the respondent, who detailed that there are certain colors used as codes by the packaging companies. These colour code indicate the toxic effects of the pesticide bottles to aware the users about the level of toxicity of a product – for example the bottle coloured red is a sign of most toxic on the other hand green denote slightly toxic. He explains that most of his fellow farmers were not at all aware about these colour codes.

As a result of the ever-increasing costs of agricultural inputs outpacing the rates of return on agricultural goods, most farmers today are in a state of serious debt. Obtaining loans to cover the essential costs of agricultural activities is crucial in this situation. Borrowing money is not always a bad thing to do if it helps you run your farm better. It is common practice for farmers to take out loans, which may be returned with the profits from their crops, even in industrialized nations. However, paying back debt is hardly a picnic for farmers in India.

Similarly, a co-relation was attempted between health problems among people who are under debt and who are not under any kind of debts taken to compensate the agricultural expenses. Table 8 depicts an association between the impact of loans or debts taken by farmers for agricultural activities on their health. During interview it was found that out of those 70 percent of the respondents who had taken any debts debt for farming, 43 percent had health problems and 27 percent had no such problems. On the other hand, out of 30 percent respondents who are not under debt, 19 percent had health issues and 11 percent did not experience any health problems.

Table 11: Association between debt and its impact on health

People who had taken debt (70%)		**People who are not under any debt (30 %)**	
43 percent mentions they are suffering from health problems	27 percent narrates they had no such health problems	19 percent accepts the fact that they are currently facing health issues	11 percent tells they are not having any health problems.

Case 29: Similarly, one more respondent quoted **"**paisa tan lagda ah, vyah karne hunde bacchya de kaye wari koi bimar ho janda ghare ustime v paisa paani wangu kharch hunda"

Translated: There are surely a lot of expenses in a family, not only marriages of children's but also if any family member is seriously ill, a lot of money is spent.

The results from the field show that Potato, Rice, Sunflower, Wheat, Onion, vegetables and fodder are the major crops cultivated in the studied area. Among these rice and wheat are the highest grown crops. Though the interviews revealed that the farmers face many problems including health problems, indebtedness, profit and yield but it was also surprising to note that almost all farmers said that they get seeds very easily for sowing of crops.

Table 12: Co-relation Between Availability of Seeds on Time with Health Conditions:

	Health conditions								
	Nothing	Diahorrea	Stomach Cramps	Fever	Diahorrea and Cramp	Cramp and Fever	All	other	Total
Availability of seeds	38.8%	2.0%	7%	6%	3%	1 %	4 %	37%	98%

In order to improve farmers' livelihoods, boost agricultural output, and tackle the issues of climate change and global food security, it is crucial to acquire high-quality seeds.

Table 12 demonstrates that 98 percent of the people surveyed agreed that seeds were easily accessible for planting. For a farmer, the supply of seeds is quite context-specific. The social standing of a farmer, the function of the crop or variety in the farming system, the connection to the market, and the agro-ecological state all affect the quality of seeds and the demand for them.

The results showed that 38.8 percent respondents were of view that there was easy availability of good quality seeds on time and having said that they also agreed to the fact that they are not having any health problems currently. On, the other hand 37

percent respondents believed that not only they have easy access to seeds but also they have certain health problems. Apart from the diahorrea, fever, stomach cramps they suffered from skin ailments and breathing problems. There were 2 percent of the respondents who said they suffer from diahorrea, 7 percent said they are experiencing stomach ailments. Also, 6 percent had fever with 3 percent saying they have diahorrea and also stomach cramps. Only, 1 percent had both cramp and fever and 4 percent said they experience almost every health problem now and then. The salient findings and recommendation are shown in the next chapter.

CHAPTER 5

SUMMARY

Not only is agriculture the main industry in India, but it is also the foundation of the Indian economy, employing over 60% of the workforce. The fundamental characteristics of rural India include our rich cultural heritage, joint family, primary relationship, and complete reliance on agriculture. The current study's findings also show that 87% of respondents rely solely on farming to support themselves; in these cases, farmers die from overwhelming debt if they have no other source of income. Additionally, individuals can experience health problems as a result of excessive stress.

Due to its agricultural methods, rural way of life, and common rural issues in the villages, India is now well-known throughout the world. The majority of exploited poor farmers own only 2–4 acres of land. It is frequently difficult for a family to make ends meet on the small amount of property. They fall short of the family's standards and are unable to effectively handle the challenges they face. Their economic, social, and political standing is ordinary, and their quality of life gradually declines.

The amount of contaminants identified as originating from agriculture has been increasing continuously. The areas with the greatest influence have been found to be agricultural soils and the surface and ground waters that are directly related to agriculture. Without a doubt, the increased percentage of harmful contaminants is due to the natural elements being exposed to human activity throughout time. A community's ability to develop or expand economically depends on the availability of reliable and clean freshwater supplies, such as groundwater. Anthropogenic variables that are known to have a direct or indirect impact on groundwater quality in rural India include urban runoff, agricultural fertilisers that contain agro-chemicals (such as pesticides), and leaching from contaminated factories and sewage dumps that contain heavy metals. A graphical representation of pesticide use by various sectors may be found in Figure 18.

The region selected for this study was chosen in order to examine the effects of the Ghaggar River's contaminated water on farming methods and crop productivity. Soil salinity and alkalinity issues in grazing areas are exacerbated by the ongoing use of

the river's contaminated waters for irrigation at addition to several additional safety precautions, this water is treated at treatment plants before being utilised for irrigation. Hazards to the environment and human health can be avoided by implementing these steps.

Farmers in the villages of Bhankarpur, Mirpur, and Mubarikpur faced a number of climate-related challenges, including unpredictable rainfall, disease outbreaks and insect infestation, seed-related problems (such tainted seeds), high seed costs, and a shortage of good-quality seeds.

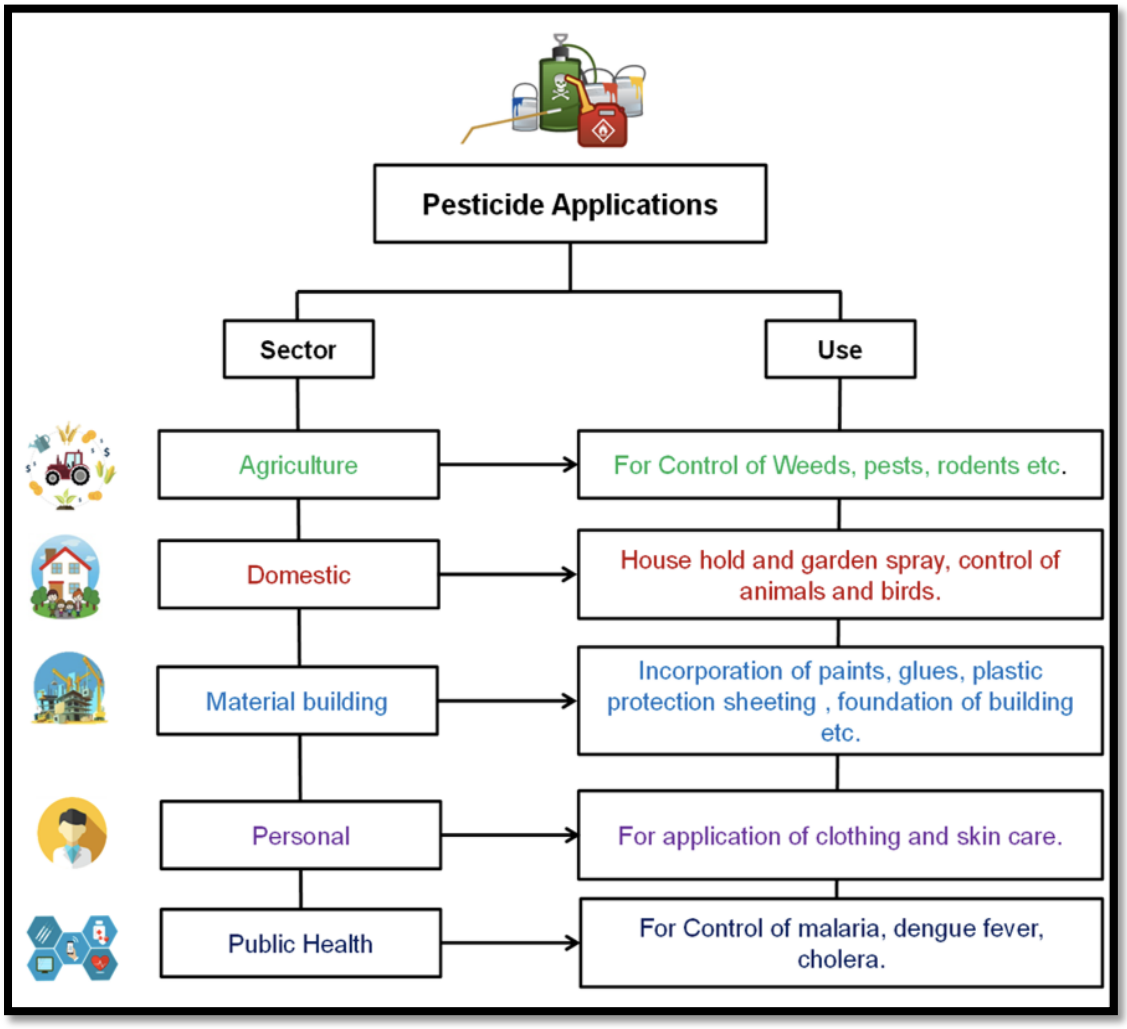

Pesticide Applications
Sector
Use
Agriculture
For Control of Weeds, pests, rodents etc.
Domestic
House hold and garden spray, control of animals and birds.
Material building
Incorporation of paints, glues, plastic protection sheeting , foundation of building etc.
Personal
For application of clothing and skin care.
Public Health
For Control of malaria, dengue fever, cholera.

Figure 18: Applications of pesticides in various sectors(Paul Muller).

It must be acknowledged, in light of the sustainable development and rural livelihoods debate and trade-off (Acharya, 2006), that in countries with a larger agricultural and rural population, it may prove to be very challenging to improve the livelihoods of rural families without compromising the environment and natural resources. For those

who are undernourished, homeless, or otherwise food insecure, meeting the needs of the current generation and their offspring takes precedence over those of future generations.

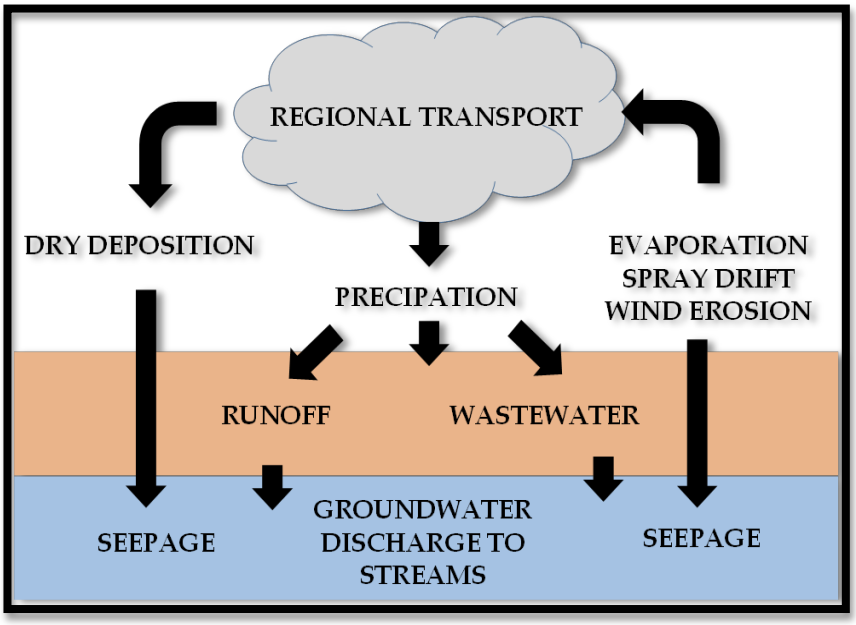


Figure 19: Pesticides Infestation in the Environment

Figure 19 shows the tragic way in which pesticides endanger the long-term viability of salient ecosystems by causing biodiversity loss and disrupting the biological connections among aquatic creatures. Agricultural fields, bodies of water, surface waterways, and ground waters are enriched with various salts due to runoffs from farms and industries. Animals and plants are vulnerable to the harmful effects of radioactive elements and trace heavy metals discharged into the environment in large quantities. Surface runoff and surface drainage are often contaminated with pesticide residues within a few weeks of their usage in intensive agricultural techniques. Besides causing a host of metabolic and reproductive issues, pesticide usage slows down the development rate.

“Present and future generations of Punjabis in India have a major problem with pesticide pollution of drinking water in the Malwa area (cotton belt) of the province (Singh, 2019)”. This contamination impacts upon an estimated 80 percent of the population. A number of lethal illnesses appear to have their roots in the region's history of over-use of pesticides. Community initiatives for safe chemical usage should be reviewed and strengthened via updated pesticide rule in order to avoid

increased chemical pollution and the health concerns it poses to the inhabitants of the area. The valuable fresh water supply of central Indian Punjab might soon be polluted due to a gradient of flow from the South-western to the central zone, caused by the rising water table in the Southwest and the falling groundwater levels in the central zone. There is observed a significant deficiency in the State's groundwater resource management and water quality monitoring.

Alternatively, according to the research of Bhadbhade et al. (2002), India accounts for three percent of the world's total pesticide usage. He looked at how pesticide overuse threatened the ecosystems and endangered several species by contaminating the surface as well as groundwater. The Indian states of Haryana and Punjab use the maximum pesticides, followed by Uttar Pradesh and Maharashtra. While consumption fell in Punjab and Haryana during 2016–2017, it rose sharply in Uttar Pradesh and Maharashtra (Yadav et al., 2015). Exposure to pesticides is recurrent on a regular basis, either directly or indirectly, according to the US Environmental Protection Agency (2016), which shares a similar opinion (USEPA 2016). Similarly, Pimentel et al. (2005) showed that pesticides may be dangerous for humans when they are inhaled or come in touch with pesticide-contaminated air, ingest pesticide-residued foods or beverages, or are exposed to pesticides at work or at home. Research by Damalas (2009) and Eleftherohorinos (2008) shows that adverse health consequences during early development may occur at very low levels of pesticide exposure.

The untreated discharge of contaminated water into agricultural fields greatly increases the likelihood of a number of environmental concerns, including chemical and bacterial pollution of groundwater, soil deterioration, and crop contamination. According to Kumarajee and Nelliyat (2008), Dera Bassi in Punjab, for instance, is home to almost 300 different businesses, including pharmaceutical, chemical, brick kiln, and countless more (Hindustan Times Mohali, 2018). Some of these factories send their effluents into a drain that connects Dera Bassi and Bhankarpur, which fall within the region under investigation. Even in the Bhankarpur, Mubarikpur, and Mirpur regions, there are several newspaper reported about how industrial waste has led to the successive decline in the ability of groundwater.

While it may not be possible to totally eliminate the risks connected with pesticide usage, there are, however, certainly ways to mitigate them. The development of novel

pesticides with safer, more effective, and environmentally friendly formulations has the potential to lessen the negative impact of sustained pesticide usage. It can further reduce the hazards by using the insecticides sparingly and only when absolutely essential. Chemical pesticides may be more effectively and environmentally eliminated from pests and insects when used in conjunction with natural therapies and cures.

Strict legal processes are applied to industries in an attempt to reduce pollution from factories. Following a complaint from the Rajasthan government, the Central Pollution Control Board (CPCB) and the Government of Rajasthan worked together on an investigation in 1996 that identified major sources of pollution in the States of Haryana, Punjab, Chandigarh, and Himachal Pradesh. Based on the findings, the CPCB issued orders to the Haryana State and Punjab State Pollution Control Board on 12.03.96 under section 18(1)(b) of the Water (Prevention & Control of Pollution) Act 1974 to stop the discharge of untreated effluents into the river water. The CPCB also instructed the Haryana State Pollution Board to control pollution in Sirsa in compliance with section 18 (1) (b) of the Water (Prevention & Regulate of Pollution) Act, 1974, in its letter no. Legal/139 (23)/90, dated 23.04.96 (cpcb.nic.in).

Leaching contaminates groundwater, which is then utilized for residential reasons. The usage of this water for irrigation has an indirect effect on those who consume the agricultural waste products. More than 40% of THE groundwater has been deemed unfit for drinking and irrigation purposes, according to the Punjab Pollution Control Board PPCB (2013). This is because industrial wastes discharge high levels of fluoride, arsenic, and residual sodium carbonate (RSC) into the water bodies. In 2015, PPCB found that the Ghaggar river, which is located near the State line, has very high levels of pollution.

- It was discovered that the biochemical oxygen demand, the amount of oxygen needed by aquatic organisms for survival, was eight times higher than the recommended levels.
- The amount of solids dissolved in the water was almost double the legal limit. Total coliform bacteria, which are present in both human and animal waste, reached an alarming 6,34,000 times the recommended threshold.

In 2017, there was recorded an alarmingly high Biological Oxygen Demand (BOD) of 240 mg/l in the downstream areas of Haryana and Punjab, which is far higher than the permissible maximum of 3 mg/L.

The paucity lack of Sewage Treatment Plants (STPs) and the subsequent disposal of untreated sewage and other non-biodegradable household wastes have a negative impact on the river, as was shown via interviews with respondents. The report provided by PPCB provided support for the cases and interviews. Sukhna Drain is a tributary of the Ghaggar River, and the study states that its water quality falls between the B and E categories, meaning that it is fine to drink but is not fit for human consumption. Therefore, according to the Central Pollution Control Board's regulations, river water is largely contaminated. It is common to observe people washing their idols and other sacred objects in the river. Animals, plants, and people alike are suffering irreparable harm as a result of the Ghaggar river's contamination by industrial effluent from Punjab and the Himachal Pradesh sewage.

The findings are backed by the reports from the PPCB and sundry press coverage from time to time. Reports from the Pollution Control Board states that chemical wastes from industry contaminate the subsoil, an essential layer of soil used for agriculture, and that river pollution is responsible for making the crops vulnerable to harm[4].

There have been several debates on the levels of pollution of the River Ghaggar and its tributaries recently. This pollution has been going on for a while now for a variety of reasons, including the disposal of untreated sewage (since there were not enough sewage treatment plants) and other non-biodegradable household garbage. The declining water quality, which was affecting the agricultural regions that were watered with this contaminated river water, has been covered extensively in the media but has received very little academic attention.

The findings show that the Ghaggar River's water quality is becoming worse with time. Many people have water-related illnesses like rashes, allergies, and even blisters. People who worked the land for extended periods of time, among the farmers, came in contact with the Ghaggar water. This was especially true for the farms

[4] (https://earth5r.org/documents/choked-sewage-industrial-effluents-in-the-Ghaggar-river/).

located near the river. This water has caused serious skin issues, especially during the monsoon. Common clothes and bare feet exposed to pesticides have resulted in causing skin irritation or even burns.

Most cases of sickness have occurred in the summer, when the river pollution was at its lowest, and during the late rainy season, when the number of cases was lower. It was also observed by the frequency of outbreaks, which occurred once or twice a year and were mostly water-related that these outbreaks included skin infections, gastrointestinal disorders, and a few minor water-related problems.

Unexpectedly, the health problems in the downstream basin were more severe than in the upstream and middle basins. During the previous time period, i.e., from 2019 to 2020, while fieldwork was being conducted, there was an increase in the frequency of health concerns due to water body pollution and poor sewage and effluent drainage in rivers. According to the incidents, farmers had to ford the river during the monsoon. During this season, not only does the water level increase, but it also introduces a vast variety and larger magnitude of pollutants such as viruses, bacteria, protozoa, and more that end up contaminating the groundwater supply. This polluted water becomes unfit for animal consumption when it combines with subterranean water. It also stops working well for home use.

Because of the high levels of fluoride, arsenic, and residual sodium carbonate (RSC), over 40 percent of the groundwater was deemed unsafe for irrigation and drinking in 2013, according to the Punjab Pollution Control Board. The Ghaggar River, which flows between the Indian States of Punjab and Haryana, was found to have very high levels of pollution later that year. Additionally, in 2017, the downstream areas in the states of Haryana and Punjab had an abnormally high biological oxygen demand (BOD) of 240 mg/l, which is far higher than the allowed maximum of 3 mg/L.

In 2019, many local NGOs visited the impacted regions due to the constant dumping of rubbish in the river. These non-governmental organizations set out to monitor the industries that were dishonestly discharging their effluent into the water supply that was subsequently being utilized for farming. "People living in the villages besides the River Ghaggar are afflicted with skin ailments, cancer, and renal difficulties," was stated by one of the respondents.

Farmers rely on pesticides and fertilizers as an integral part of their practise. Chemicals used singly or in combination with certain solvents to control, eradicate, or otherwise deal with unwanted plants, insects, fungus, and rodents are known as pesticides (Giliomee, 2009). During the monsoon season, runoff water from fertilized fields carries these dangerous chemicals away from the application site, where they may bioaccumulate in living organisms.

Despite the presence of the *gaushala* (cowsheds), one respondent recounts how the animals continue to trample the crops. Farmers have long relied on traditional scaffoldings to perch themselves atop their scaffolds or machan as they monitor strays. Barbed wire fencing is used by the more well-off farmers to control the population of feral animals. Due to the high cost, it is out of reach for the impoverished farmers. Several media reports have depicted the devastating effects of crop destruction and its impact on farmers. News stories about stray animals and wild animals destroying crops have been mentioned in print and electronic media on several occasions, as shown in Table 6. There are many examples of stray cattle invading rural areas and ruining the dreams, of a bumper harvest harboured by several farmers. This Table-6 provides a concise summary of many such cases.

The news story of the large scale invasion of farms by herds of undomesticated cows has been reported in the media. Massive herds of these creatures wreak havoc on farms they invade, leaving farmers and ranchers with little room for defence. In addition to destroying crops like sugarcane and corn, wild boars feed on vegetables. When these wild cows become angry, they tend to become violent, damaging crops and even people. In a single swoop, they destroy the crop and go back into hiding.

A comparison between conventional farming and organic farming has been based on the case studies as it is clear that this research has stressed the significance of organic farming, which uses eco-friendly methods. They influence increasingly the business and economic sides of organic farming.

Some of the respondents described a wide variety of elements that had an impact on the reaping of a successful harvest.

Table 13: News on stray animal attacks on crop fields in Punjab

(News Reports in Print and Electronic Media)

Date	Incidence
29/08/2016	"Stray bull runs amok in Patiala, kills one, injures another. A stray bull killed a man by piercing his eyeball and puncturing his lungs and kidneys with his horns, here on Sunday. Another person, who also came under the bovine's attack, has sustained injuries and is admitted at a hospital."
08/07/2017	"Dogs mutilated four-year-old Harman Singh of Bishangarh village in Sanaur, and he had to undergo plastic surgery of the face. The child was attacked by a group of dogs. Two students were injured in Patran when they were attacked by dogs. They were on way to their school."
15/12/2017	"In the Bet (floodplains along the river) area, herds of roz (feral cows) come out of nowhere at night and invade the farms. The stray cattle menace has spilled over from cities to villages, grazing down farmers' hopes of a good harvest year after year."
22/12/2017	"MOGA: Farmers in the district, the heartland of Malwa belt in Punjab, are facing the problem of stray cattle destroying their wheat, mustard and other crops with hardly any efforts by the district administration to tackle the problem."
8/03/2019	"Protesting against strays, Punjab farmers let them loose"
10/02/2019	"Farmers' bodies are up in arms against the growing problem in the State"
25/02/2020	"Stray cows and wild boars enter farmers' fields and destroy crops. It has become a common problem for them and the growers have been left troubled and worried. The moment stray animals enter their fields, farmers run after them and chase them out."
14/12/2022	"Stray cattle menace: Farmers stage protest outside district administrative complex in Sangrur"
10/07/2022	"Bharti Kisan Union-Lakhowal (BKU) has called upon the state government to take effective steps against stray and pet cattle roaming in towns and villages to save crops and forests from damages."

Source: Compiled by Researcher
Note : All references of news items in bibliography

The current research has found that most horticultural farmers in the Mohali region of Punjab were well into their productive and economic prime, and they had extensive expertise in the field. The previously mentioned cases indicate that the region has the potential for increased organic horticulture outputs that can be sustained over time. The farmers participating in the survey were well-versed in and frequently used all of the recommended agricultural techniques. Organic farming was preferred by 68.7 percent of the respondents. Several factors such as time, transportation, lack of credit and storage facilities, climate change, capital intensiveness, lack of extension agents, and technical know-how were responsible for the small section of the farmers adopting this practise, however.

The respondents advised some measures to stop the Ghaggar water from deteriorating further in terms of contamination and usability. According to the residents, washing, bathing and dumping of untreated domestic waste by the residents living in the vicinity of the Ghaggar River should be prohibited.

During the data collection it was observed that the study area had a huge number of migrants from Bihar and Uttar Pradesh residing in the locality of the river. These residents were financially weak and maximum most of them are daily wagers. In many cases they were found polluting the Ghaggar water intentionally or un-intentionally by throwing the domestic waste into the river. Not only this, they were found cleaning and washing the cattle in the water. Open defecation and Faecal discharge by the nearby residents on the banks of the Ghaggar River was also one of the reason for the high levels of contamination and poor water quality.

CHAPTER 6

RECOMMENDATION

- The use of harmful pesticides has several detrimental effects on both the environment and human health. Therefore, it is critical to include up-to-date information on the various pesticide qualities derived from their physical and chemical composition. The conversion of pesticides into their environmental impacts and behaviours may be better regulated using this.
- Although pesticides have indirectly benefited society and increased agricultural output, they are been a blessing in economic profit disguise for agronomists.
- Furthermore, before being discharged into the environment, these pesticides need to be converted to non-toxic chemicals under proper monitoring.
- It is imperative that specific communities and agencies of environmental monitoring, evaluation control and protection collaborate on strategies to decrease the detrimental environmental impact of chemical contamination.
- The government must arrange public education initiatives and awareness drives to persuade people living in rural regions to value water conservation and safeguard aquatic resources from pesticide contamination.
- Before these bodies of water and the people who are dependent upon them are endangered any further quickly action must be taken to protect them.
- The water quality of local water systems, bodies of water, streams, and channels—whether publicly or privately run—must be immediately monitored and reported to the Environmental Protection Agency.
- One of the issues that farmers recurrently encountered was stray livestock ruining their crops. The research region was particularly plagued by the danger of wild animals. Therefore, it is essential to take the necessary precautions to protect the crops.
- The use of dangerous, banned, highly toxic pesticides, insecticides and fertilizers but be stopped at the earliest.
- Banned pesticides should be taken of all sales lists.

- Thorough monitoring of wholesale and retail outlets of pesticides and other noxious agricultural inputs should be stopped althoughter.
- Alternative cropping patterns should be considered
- Cooperative bodies should be made aware and active in this campaign.

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According to http://www.pbplanning.gov.in/

Banned and Severely Restricted Pesticides

The U.S. Environmental Protection Agency (EPA) prepares a list of banned and severely restricted pesticides list as part of its participation in an international program known as the Prior Informed Consent (PIC) procedure.

Banned Pesticides

A "Banned" pesticide is defined as a pesticide for which all registered uses have been prohibited by final EPA action to protect human health or the environment. It includes pesticides that have been refused approval for first-time use or have been withdrawn by industry. See the back of this factsheet for a list of pesticides that have been banned in the United States.

Severely Restricted Pesticides

A "Severely Restricted" pesticide means a pesticide for which virtually all registered uses have been prohibited by final EPA regulatory action, but for which certain specific registered use or uses remain authorized.

Table 1: U.S. Severely Restricted Pesticides

Sr. No.		
1	arsenic trioxide	Lindane
2	carbofuran (granular only)	Pentachlorophenol
3	daminozide/alar	sodium arsenate
4	heptachlor	tributyltin compounds

Source: *Colorado ChemSweep Pesticide Waste Collection Program*. 2002.

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U.S. Banned Pesticides	
Aldrin	Ethyl Hexyleneglycol [6-12]
Benzene Hexachloride [BHC]	Fluoroacetamide
2,3,4,5-Bis (2-Butylene) Tetrahydro-2- Furaldehyde [Repellent-11]	Hexachlorobenzene [HCB]
Bromoxynil Butyrate	Lead Arsenate
Cadmium Compounds	Leptophos
Calcium Arsenate	Mercurous Chloride
Captafol	Mercuric Chloride
Carbon Tetrachloride	Mevinphos
Chloranil	Mirex
Chlordane	Monocrotophos
Chlordecone [Kepone]	Nitrofen (TOK)
Chlordimeform	Ompa (Octamethylpyrophosphoramide)
Chlorinated Camphene [Toxaphene]	Phenylmercury Acetate [PMA]
Chlorobenzilate	Phenylmercuric Oleate [Pmo]
Chloromethoxypropylmercuric Acetate [CPMA]	Potassium 2,4,5-Trichlorophenate [2,4,5-TCP]
Copper Arsenate	Pyriminil [Vacor]
Cyhexatin	Safrole
Dbcp	Silvex
Ddt	Sodium Arsenite
Dieldrin	Tde
Dinoseb And Salts	Terpene Polychlorinates [Strobane]
Di (Phenylmercury) Dodecenylsuccinate [PMDS]	Thallium Sulfate
1,2-Dibromoethane Ethylene Dibromide [EDB]	2,4,5-Trichlorophenoxyacetic Acid [2,4,5-T]
Endrin	Vinyl Chloride
EPN	

LIST OF PESTICIDES WHICH ARE BANNED, REFUSED REGISTRATION AND RESTRICTED IN USE

(Updated on 31.03.2024)

I. PESTICIDES/FORMULATIONS BANNED IN INDIA

A	**Pesticides Banned for Manufacture, Import and Use**
1.	Alachlor (S.O.3951(E),dated 08.08.2018)
2.	Aldicarb (S.O.682 (E)dated 17th July 2001)
3.	Aldrin
4.	Benzene Hexachloride
5.	Benomyl (S.O3951(E) dated 8th August, 2018)
6.	Calcium Cyanide
7.	Carbaryl (S.O3951 (E) dated 8th August, 2018)
8.	Chlorbenzilate (S.O.682 (E) dated 17th July 2001)
9.	Chlordane
10	Chlorofenvinphos
11	Copper Acetoarsenite
12	Diazinon (S.O3951 (E) dated 8th August, 2018)
13	Dibromochloropropane (DBCP) (S.O.569 (E) dated 25th July 1989)
14	Dichlorovos (S.O.3951 (E),dated 08.08.2018)
15	Dicofol (S. O. 4294 (E) dated 3rd October, 2023)
16	Dieldrin (S. O. 682 (E) dated 17th July 2001)
17	Dinocap (S.O. 4294 (E) dated 3rd October, 2023)
18	Endosulfron (ad-Interim order of the Supreme Court of India in the Writ Petition (Civil) No.213 of 2011 dated 13th May, 2011 and finally disposed of dated 10th January, 2017)
19	Endrin
20	Ethyl Mercury Chloride
21	Ethyl Parathion
22	Ethylene Dibromide (EDB) (S.O.682 (E)dated 17th July 2001)
23	Fenarimol (S.O3951(E) dated 8th August, 2018)
24	Fenthion (S.O3951(E) dated 8th August, 2018)
25	Heptachlor

26	Lindane (Gamma-HCH)
27	Linuron (S.O3951 (E) dated 8th August, 2018)
28	Maleic Hydrazide (S.O.682 (E) dated 17th July 2001)
29	Menazon
30	Methomyl (S.O.4294 (E) dated 3rd October, 2023)
31	Methoxy Ethyl Mercury Chloride (S.O3951 (E) dated 8th August, 2018)
32	Methyl Parathion (S.O3951(E)dated8thAugust,2018)
33	Metoxuron
34	Nitrofen
35	Paraquat Dimethyl Sulphate
36	Pentachloro Nitrobenzene (PCNB) (S.O.569 (E) dated 25th July1989)
37	Pentachlorophenol
38	Phenyl MercuryAcetate
39	Phorate (S.O.3951(E),dated 08.08.2018)
40	Phosphamidon (S.O.3951 (E), dated 08.08.2018)
41	Sodium Cyanide (banned for Insecticidal purpose only S.O3951 (E) dated8th August, 2018)*
42	Sodium Methane Arsonate
43	Tetradifon
44	Thiometon (S.O3951 (E) dated 8th August, 2018)
45	Toxaphene (Camphechlor) (S.O.569 (E) dated 25th July1989)
46	Triazophos (S.O.3951(E),dated 08.08.2018)
47	Tridemorph (S.O3951(E) dated 8th August, 2018)
48	Trichloroaceticacid (TCA) (S.O.682 (E) dated17thJuly2001)
49.	Trichlorfon(S.O.3951(E),dated 08.08.2018)
B.	**Pesticide/Pesticideformulationsbannedforusebutcontinuedtomanufacture for export**
1.	Captafol 80% Powder (S.O.679 (E) dated 17th July 2001)
2.	Dichlorvos (S.O.1196(E) dated 20th March 2020)
3.	Nicotin Sulfate (S.O.325(E) dated 11th May 1992)
4.	Phorate (S.O.1196 (E) dated 20th March 2020)
5.	Triazophos (S.O.1196(E) dated20th March 2020)

C	**Pesticides Withdrawn (With drawal may become in operative as soon as required complete data as per the guidelines is generated and submitted by the Pesticides Industry to the Government and accepted by the Registration Committee. (S.O 915(E) dated 15th Jun,2006)**
1.	Dalapon
2.	Ferbam
3.	Formothion
4.	NickelChloride
5.	Paradichlorobenzene (PDCB)
6.	Simazine
7.	Sirmate (S.O.2485(E) dated 24th September 2014)
8.	Warfarin(S.O.915(E) dated15th June2006)

*Regulationtobecontinuedintheextantmannerfornon-insecticidaluses.

II. PESTICIDES REFUSED REGISTRATION

S.No.	Name of Pesticides
1.	2,4,5-T
2.	Ammonium Sulphamate
3.	Azinphos Ethyl
4.	Azinphos Methyl
5.	Binapacryl
6.	Calcium Arsenate
7.	Carbophenothion
8.	Chinomethionate (Morestan)
9.	Dicrotophos
10.	EPN
11.	Fentin Acetate
12.	Fentin Hydroxide
13.	Lead Arsenate
14.	Leptophos (Phosvel)
15.	Mephosfolan
16.	Mevinphos (Phosdrin)
17.	Thiodemeton /Disulfoton
18.	Vamidothion

III. PESTICIDES RESTRICTED FOR USE IN THE COUNTRY

S. No.	Name of Pesticides	Details of Restrictions
1.	Aluminium Phosphide	The Pest Control Operations with Aluminium Phosphide may be undertaken only by Govt. /Govt. undertakings / Govt. Organizations / pest control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India except 1 Aluminium Phosphide 15% 12g tablet and [2]Aluminum Phosphide 6 % tablet. [RC decision circular F No. 14-11(2)-CIR-II (Vol. II) dated 21- 09-1984 and G.S.R. 371(E) dated 20th may 1999]. [1]Decision of 282nd RC held on 02-11-2007 and, [2]Decision of 326th RC held on 15-02-2012. The production, marketing and use of Aluminium Phosphide tube packs with a capacity of 10 and 20 tablets of 3 g each of Aluminium Phosphide are banned completely. (S.O.677 (E) dated 17th July, 2001)
2.	Captafol	The use of Captafol as foliarspray is banned. Captafol shall be used only as seed dresser. (S.O.569(E) dated 25th July, 1989) The manufacture of Captafol 80 % powder for dry seed treatment (DS) is banned for use in the country except manufacture for export. (S.O.679(E) dated 17th July, 2001)
3.	Carbofuran	All other formulations of Carbofuran except Carbofuran three percent Encapsulated granule (CG) along with the croplabels may be stopped from use (S.O.4294 (E) dated 3rd October, 2023)
4.	Chlorpyriphos	Chlorpyriphos is banned for use in Ber, Citrusand Tobacco. (S.O. 4294(E) dated 3rd October, 2023)
5.	Cypermethrin	Cypermethrin3% Smoke Generator is to be used only through Pest Control Operators and not allowed to be used by the General Public. [Order of Hon'ble High Court of Delhiin WP(C)10052of2009dated1407-2009and LPA-429/2009 dated 08-09-2009]

6.	Dazomet	The use of Dazomet is not permitted on Tea. (S.O.3006 (E) dated 31st Dec, 2008)
7.	DicohlroDiphenyl Trichloroethane (DDT)	The use of DDT for the domestic Public Health Programme is restricted up to 10,000 Metric Tonnes perannum, except incase of any major out break of epidemic. M/s Hindustan Insecticides Ltd., thesole manufacturer of DDT in the country may manufacture DDT for export to other countries for use in vector control for public health purpose. The export of DDT to Parties and State Non- Parties shall be strictly in accordance with the paragraph 2(b) article 3 of the Stockholm Convention on Persistent Organic Pollutants (POPs). (S.O.295(E) dated 8th March, 2006) Use of DDT in Agriculture is withdrawn. In very special circumstances warranting the use of DDT for plant protection work, the state or central Govt. may purchase it directly from M/s Hindustan Insecticides Ltd. to be used under expert Governmental supervision. (S.O.378(E) dated 26th May,1989)
8.	Dimethoate	Dimethoate is banned for use in fruits and vegetables that are consumed as raw food items. (S.O.4294(E) dated 3rd October, 2023)
9.	Fenitrothion	TheuseofFenitrothionisbannedinAgricultureexceptforlocustcontrolin scheduled desert area and public health. (S.O.706 (E) dated 03rd May, 2007)
10.	Malathion	Malathion is banned for use on Sorghum, Pea, Soybean, Castor, Sunflower, Bhindi, Brinjal, Cauliflower, Radish, Turnip, Tomato, Apple, Mango and Grape. (S.O.4294(E) dated 3rd October, 2023)
11.	Mancozeb	Mancozeb is banned for use on Guava, Jowarand Tapioca. (S.O. 4294(E) dated 3rd October, 2023)
12.	MethylBromide	Methyl Bromide may be used only by Govt. /Govt. undertakings/Govt. Organizations / Pest control operators under the strict supervision of Govt. Experts or Experts whose expertise is approved by the Plant Protection Advisor. [G.S.R.371(E) dated 20th May, 1999 and earlier R Cdecision]

13.	Monocrotophos	Monocrotophos is banned for use on vegetables. (S.O.1482 (E) dated 10th Oct, 2005) 1) The use of Monocrotophos 36% SL formulation is to be discontinued and no new certificate of registration for its manufacture shall be issued after publication of S.O. 4294(E) dated 3rd October, 2023. 2) Withanobjectiveofprovidingalternativesofthisformulationsothatthe farmers do not suffer losses due to non-availability of effective control against certain insect pests in specific crops, the label claims for other formulations of Monocrotophos may be extended in one-year period from the date of publication of S.O. 4294(E) dated 3rd October, 2023. 3) After this period, all the certificates of registration of Monocrotophos36% SL will stand cancelled. Sale, distribution or use of Monocrotophos 36% SL shallbeallowedonlyforclearanceofexistingstocktillitsexpiryperiod.(S.O.4294(E)dated3rdOctober,2023)
14.	Oxyfluorfen	Oxyfluorfen is banned for use on Potatoand Groundnut. (S.O. 4294(E) dated 3rd October, 2023)
15.	Quinalphos	QuinalphosisbannedforuseonJute,CardamomandSorghum. (S.O. 4294(E) dated 3rd October, 2023)
16.	Trifluralin	i. The Registration, import, manufacture, formulation, transport, sell and its all uses except use in wheat shall be prohibited and completely banned from 8th August, 2018. ii. A cautionary statement has to be incorporated in the label and leaflet that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area. (S.O3951(E)dated8thAugust, 2018)

According to Pragati Tiwari (2024) Fertilizers are an important industry in India. Substantial increases in the production and consumption of fertilizers were responsible for our country's significant increase in agriculture. It is estimated that, through the combination of water and fertilizers, an increase in output could be

around 70%. The fact that fertilizer is a costly agricultural input has been recognized as having an essential role to play in reducing the costs per unit of produce. Fertilizer is an organic or inorganic product which has been mixed into a soil from natural or synthetic sources. Organic fertilizers derived from one or more of those sources include animal manure, household waste, plant materials and soil organic material including the crops residues. Organic farming contributes to soil quality by increasing the structure, chemistry and bioactivity of soils. Inorganic fertilizers are the major nutrients provided for plant growth, such as nitrogen, phosphorus and potassium. Secondary inorganic nutrient fertilizers are calcium, magnesium, sodium and sulphur. Inorganic micro-nutrient fertilizers are required in small quantities such as boron, cobalt, copper, iron, manganese, etc. This organic and inorganic fertilizer made through the fertilizer companies such as IPL, SPIC, MFL, KRIBHCO, IFFCO, RCF, COROMONDEL, and FACT.

Historical Background

India's Green revolution brought situation of self-sufficiency in crop production during the 1960s. India needed to import food grain from the US and Mexico before then so that population can be fed. After almost 50-60 years of Green Revolution India is in a stage of exporting food grain to other countries also. India has to rely on imports of phosphatic and potassium fertilizer. There is a central administration Department of Fertiliser to manage the production scenario, transport of fertilizers to different states, necessary and affordable price and availability to all farmers.

The Government of India has been actively working to improve availability and optimize fertilizer use in India. A series of policy actions have been adopted to ensure that fertilizers are available and distributed in the timely and proportionate way. Two types of subsidies shall be granted to fertilizer companies for the purposes of taking care of them production subsidy and freight subsidy.

The adoption of the Green Revolution in the 1960s had a major impact on the production of food grains in the country, which was largely dependent on imports to meet demand. Further experience shows that productivity and output increase through the increased use of fertilizers in an appropriate proportion. Therefore, fertilizers have become an integral part of India's agricultural sector in order to increase yields. There are a number of factors that influence the use of fertilizers, such as irrigation, high

yield variety seed, size of agricultural credit etc. The increase in the area under high yield varieties has contributed to a growth of food grain production.

Nitrogen, Phosphorus and Potassium are essential nutrients to be added to soil by means of fertilizers. It is also necessary to add micronutrients such as calcium, magnesium, manganese, boron etc. There must be sufficient balance between the three components of nutrients nitrogen, potassium and phosphate. The imbalance is result of usage of more nitrogen and less soil use for phosphorus and potassium. The demand for fertilizer depends upon the price of a crop, price of fertilizer and price of other inputs complementary to fertilizer.

India's Population had grown after independence. Farmers were no longer able to produce huge amounts of food grains due to natural farming. Therefore, Government had to import food grains in 1950 to 1960. The green revolution was launched in 1960s. This was the time for a fresh start. India has attained self-sufficiency in food grain production slowly over the last few years. Fertilization has a significant role to play in the cultivation of crop and food grains, as fertilizers increase soil fertility. That's why the farmer started using it more. India was incapable of producing that much fertilizer at this point in time to meet the needs of farmers, then started to import it.

Government has established some joint venture outside India also. Government of India is Having Seven Joint Ventures Abroad. These are as follows -

- FOSKOR (Pty) Limited South Africa supplying phosphoric acid
- ICS Sengel & ICS Sengel (exp.) for supplying phosphoric acid
- Indo Maroc Phosphore S.A (IMACID) at Morocco for supplying phosphoric acid
- Tunisian Indian Fertilizers (TIFERT), Skhira Tunisia for supplying phosphoric Acid
- Jor dan India Fertilizer Company, Eshidiya Jordan for supplying phosphoric acid
- Oman India Fertilizer Company, Muscut Oman for supplying urea
- One more joint venture is proposed names JV at Gabon

2. REVIEW LITERATURE

 Rajesh Kumar Bishnoi & Abhijit Das (2020) paper focuses on the growth rate of India's fertilizer sector, demand and supply side. The consumption patterns of fertilizers in Indian states are also discussed. Secondary data shall be obtained from publicly available sources and information provided in the open market.

 Yudhishther Singh Bagal (2018) in this study an in-depth analysis is done with fertilizer consumption pattern at Kotli village in Jammu and Kashmir. A total of 79 farmers were randomly without replacement selected and were interviewed with the help of well-structured interview schedule. The findings showed that the majority of farmers were marginal.

 Abhishek Pathak, Pushkar Dubey, Sanjay Pandey (2017) provides an overview of the market, circumstances, range and overall situation of fertilizer marketing in India. Fertilizer marketing plays an essential role in order to meet the needs of farmers. The farmer class, academics, and marketers are included in its reach.

State Wise & Zone Wise Consumption of Fertiliser in India

The states of Jharkhand, Assam, West Bengal and Orrisa are in the East Zone. The states of Rajasthan, Madhya Pradesh, Gujarat, Goa and Maharashtra are part of the West Zone. States of the northern zone are Delhi, J&K, Punjab, Haryana, Uttarakhand, Himachal Pradesh and Uttar Pradesh. South Zone states are Karnataka, Lakshadweep, Kerala, Tamil Nadu and Andhra Pradesh. North East zone includes Sikkim, Tripura, Assam, Mizoram, Meghalaya, Nagaland and Arunachal Pradesh.

State wise Consumption of Fertilizers in Year 2019-20 (in Thousand Tons)		
South Zone		
1	Pondicherry	30.76
2	Karnataka	2058.48
3	Andhra Pradesh	3061.37
4	Tamil Nadu	1196.85
5	Lakshadweep	0.00
6	A&N Islands	0.71
7	Kerala	264.89
Sub-Total (South Zone)	**6613.06**	
West Zone		
8	D&N Haveli	1.21

9	Chhattisgarh	537.14
10	Goa	9.1
11	Maharashtra	3065.46
12	Madhya Pradesh	1661.17
13	Gujarat	1799.72
14	Daman & Diu	0.46
15	Rajasthan	1073.21
Sub-Total (West Zone)	**8147.47**	
North Zone		
16	Uttarakhand	155.31
17	Punjab	1865.62
18	Jammu & Kashmir	111.67
19	Chandigarh	0
20	Himachal Pradesh	53.24
21	Haryana	1355.69
22	Delhi	2.35
23	Uttar Pradesh	4261.5
Sub-Total (North Zone)		**7805.38**
East Zone		
24	West Bengal	1644.56
25	Jharkhand	167.35
26	Bihar	1309.86
27	Orissa	519.34
Sub-Total (East Zone)		**3641.11**
North East Zone		
28	Sikkim	0
29	Tripura	14.2
30	Arunachal Pradesh	0.82
31	Meghalaya	3.68
32	Nagaland	0.94
33	Assam	242.27
34	Mizoram	5.47
35	Manipur	12.04
Sub-Total(North East Zone)		279.42
All India		**26486.4**

(Source – The Fertilizer Association of India)

The three most fertilizer consumption states for the period from financial year 2019-20 were Uttar Pradesh, Andhra Pradesh and Maharashtra. No fertilizer is used by three Indian States and Union Territories namely Chandigarh, Lakshadweep and Sikkim. Because it does not have any agriculture related practices and its farming methods are completely based on organic agriculture. Very less amount of fertilizers is used by Arunachal Pradesh, Nagaland, Daman & Diu and Andaman & Nicobar. The share of overall fertilizer use by region is shown. East and North East regions of India are using less fertilizer while the southern, northern and western areas of India tend to use more. The share of Western India was the highest, followed by North and South.

Consumption of Fertilizers in India

Year	**(in Thousand Tons)**
Total	
2011-12	27,790.20
2012-13	25,536.20
2013-14	24,482.40
2014-15	25,581.30
2015-16	26,752.60
2016-17	25,949.90
2017-18	26,593.40
2018-19	27,228.20
2019-20	29,370.40
2020-21	32,535.60
2021-22	29,796.30

(Source – The Fertilizer Association of India)

Fertilizer consumption is increasing steadily from 2011-12 to 2021-22. Fertilizer production is increasing from 2011-12 to 2021-22. Production is 38858300 tons in year 2011-12 in India. It is decreasing till 2014-15. But after that, it is increasing continuously till 2020-21. There is highest production in Financial Year 2021-22 with 43743000 tons. Overall, there is increment in this decade in terms of fertilizer production.

Fertiliser Production in India

Year	Total Fertilizers Productions
(in Thousand Tons)	
2011-12	38,858.30
2012-13	37,606.90
2013-14	38,180.60
2014-15	38,718.80
2015-16	41,597.70
2016-17	41,427.70
2017-18	41,560.80
2018-19	41,564.00
2019-20	42,752.20
2020-21	43,483.50
2021-22	43,743.00

(Source – The Fertilizer Association of India)

Government needs to take into account factors other than prices such as better seeds, irrigation and credit in order to increase the use of fertilizers in this country. Fertilizer subsidy is a more appropriate means of achieving the objectives in comparison with price support policy. More effective targeting of these subsidies is needed.

LIST OF INSECTICIDE

Sl. No	Trade name	Chemical Composition	Mode of Action	Active ingredient	Recmdn.	Against
1	Acephate/ Asatof/ Starthene	O-S Dimethyl acetylphosphoramidothioate	S	75% wp	0.75-1 g/ltr	Aphids, jassids, bolllworms
2	Actara	Thiamethoxam	S	25%	0.2g/l	Sucking pest, Aphids, Hoppers, WF, Root grub
3	Admire	Imidacloprid	S	70% WG	0.5-0.8ml/ltr	Sucking pests
4	Avaunt	Indoxacarb	C	15.8%EC	0.5-0.8ml/ltr	DBM, Bollworm
5	Confidor	Imidacloprid	S	17.80%	0.25-0.5ml/l	Sucking pests
6	Corogen	Chlorantraniliprole	C	18.50%	0.5 ml/l	Borer & Caterpillar
7	Curacron	Profenofos	C	50% EC	1.5-2 ml/l	Bollworm, sucking pests (15dsys)
8	Cymbush	Cypermethrin	C	25% EC	0.5ml/l	Borer, bollworm, sucking pests
9	Decis	Deltamethrin	C	2.8% EC	1ml/l	Leafminor, white flies
10	Dursban	Chlorpyrifos	C	20% EC	1.5-2.5 ml/l	Leaf hopper, BPH, termites, sucking pests
11	Ekalux	Quinolphos	C	25%	0.5-1.5ml/l	sucking pests, borer,
12	Fame	Flubendiamide	S	39.35%	1 ml/l	Borer & Caterpillar
13	Furadon/Tata Furan	Carbofuron	S	3%G	5 kg/acre	stem borer, cutworm white grub, termite, shootfly, stem borer, aphids, thrips, jassids

14	Hostathian	Triazophos	CTL	40% EC	1ml/ltr	Leaf minor, white flies
15	Jump	Fipronil	S	80%	0.2g/l	Sucking pests
16	Karate	Lambda-cyhalothrin	C	5% EC	0.5ml/ltr	Borer, weevils, aphids, jossids, thrips, whiteflies
17	Colonel-S	Dicofol	C	18.50%	2.7ml/l	Mites
18	Lannate	Methomyl	C	40%	1 ml/l	Bollworms, borer, succing pests
19	Larvin	Thiodicarb	C	75%WP	2-3 g/l	Bollworm,shoot & fruit borer,pod borer, DBM
20	Magister	Fenazaquin	S	10%	0.5 ml/l	Mites
21	Malathion	Melathion	S	50% EC	1 ml/l	caterpillars, fruitborer, gallmidge fly,leaf eating caterpillar, stem borer
22	Marshal [liquid]	Carbosulfan	C	25% EC	1-1.5ml/l	Aphid, borer, hoppers
23	Matador	Lambda-cyhalothrin	C	4.9% EC	0.5 - 0.7 ml	Borer in paddy & cotton
24	Metasystox	Oxidematon methyle	S	25%EC	2 ml/l	Sucking pests
25	Nuvan	Dichlorvos	C	76%EC	0.5-1.0ml/l	cut worms, leaf roller, aphids, sucking pests
26	Monostar/Tata Mono	Monocrotophos	C	36%	1ml	Succing pests, bollworm
27	Oberan	Spiromesifen	C	22.9%	0.2ml/l	Mites
28	Politrin-C	Profenofos + Cypermethrin	C	40 %+4%	1-1.5ml/l	Bollworm, sucking pests (15dsys)
29	Pegasus	Diafenthiuron	C	50%	1.25g/l	Pod borer, fruit borer,

30	Proclaim	Emamectin benzoate	Biological insecticide	5% SG	00.5g/ltr	Bolworm, fruit & shoot borer
31	Regent	Fipronil	C & S	5%	1-1.5ml/l	Borer, bollworm, sucking pests
32	Pride/ Rekord	Acetamiprid	S	20% SP	0.2 g/l	Aphids,jassids,thrips,whitefly
33	Rogar	Dimethoate	S	30%	1-1.3ml/l	Borer, mites, catterpillars, sucking pests
34	Sevin	Carbaryl	C	50% WDP	4g/l	Borer, bollworm, sucking pests
35	Spark	Deltamethrin + Triazophos	C	1%+35%	1.5ml	Succing pests, bollworm & leaf minor
36	Starphor	Phorate	S	10%	25-30 kg/ha	Trrmites,nematodes
37	Thimet	Phorate	S	10%G	30kg/ha	Termites, nematodes
38	Vertimac	Abamectin	S	1.90%	0.25 - 0.5ml	Spoders & mites in ornamentals
39	Wetttasul -80	Sulphur	C	80% WP	2-5g/l	Mites

LIST OF FUNGICIDE & BACTERICIDE

Sr.No	Trade name	Chemical concentration	Mode of Action	Active ingredient	Recmdn.	Against
1	Aliette	Fosetyl-AL	S	80 % WP	1 g/l	DM
2	Amistar	Azyoxystrobin	S	23% SC	1ml/ ltr	DM & PM in vegetables & grapes
3	Aureofungin	Aureofungin	S	46.15 SP	0.1 g/lit	Bacterial diseases
4	Beam	Tricyclazole	S	75% WP	0.5 - 0.8g	Paddy blast &sheath blight
5	Bavistin	Carbendaziem	S	50%	2g/Kg or 0.5g/l	Blasts, blight, PM, rots, wilts
6	Bayleton	Traidimefon	S	25% WP	0.5g	Powdery mildew & Rust (25-40 days)
7	Benomyl/Benofit	Benomyl	S	50% WP	0.5ml/l	PM, Anthrachnose, leaf spot, rots, rust
8	Blitox	COC	C	50% WP	2.5ml/l	Rots, leaf spots, damping off,
9	Calixin	Tridemorph	S	80% EC	0.5 -1 ml/lit	PM, wilts
10	Captan/Foltaf/ Captaf	Captan	C	50% WP	2 - 2.5g/ltr	Daming off, rots
11	Contaf	Hexaconozole	S	5%	0.5-1ml/l	PM
12	Cuman	Ziram	C	27% SL	1ml/ltr	Blight, DM, Anthrachnose
13	Curzate M8	Cymoxanil + Mancozeb	C & S	8 % + 64%	3 g/l	Late blight, DM
14	Equation Pro	Famoxadone +Cymoxanil	C & S	16.6%+22.1%	1 ml/l	Late blight,DM

15	Folicur	Tebuconazole	S	25.9% m/m	2.5 ml/l	Tikka, Rust, Sheath blight, Dieback, Anthracnose, Spots
16	IM-45/ Abic M-45	Indofil-Mancozeb	C	45%	2-2.5g/l	Blasts, blight, DM, rots, Leaf spots, buck eye rot,
17	Kavach	Chlorthalonil	C	75%	1-2g/l	Fruit rots, rust, blight, DM (Grape) (10-60 days)
18	Karathane	Dinocap	S	48% EC	0.3-0.5ml/l	PM
19	Kocide	Copper hydroxide	C	77WP	2 g/l	Anthracnose, Cercospora, Leaf spot
20	Quintal 50WP	Iprodione + Carbendazime	C & S	25% +25%	1g/ltr	Sheath blight & blast in rice
21	Ridomil	Metalaxyl + Mancozeb	C & S	4%+ 64%	1-1.5g/lt	Wilts, leaf spots, downy mildew, fruit rot, late blight
22	Rovral	Iprodione	C	50 WP	1g/lit	Botrytis, Damping off, Wilt, Early and late blight & molds
23	Rubigan -f	Fenarimol	S	12 % EC	0.5 ml/l	PM
24	Streptocycline	Streptomycin sulphate +Tetracycline	S	90%+ 10%	0.1g/l	bacterial diseases
25	Tilt	Propiconozole	S	25% EC	0.5ml/l	Rust, leaf spots, blight,
26	Topsin/ Roko/ Moti	Thiophenate-Methyl	C	70%	1g/l	Anthrachnose, PM, Blight, Blast, Smut, Wilt, Rot
27	Topas	Penconazole	S	10 % EC	0.5 ml/l	PM
28	Wet.Sulphur/ sulfex	Wettable sulphur	C	80%	2-5g/l	PM, mites

LIST OF ORGANIC CHEMICALS

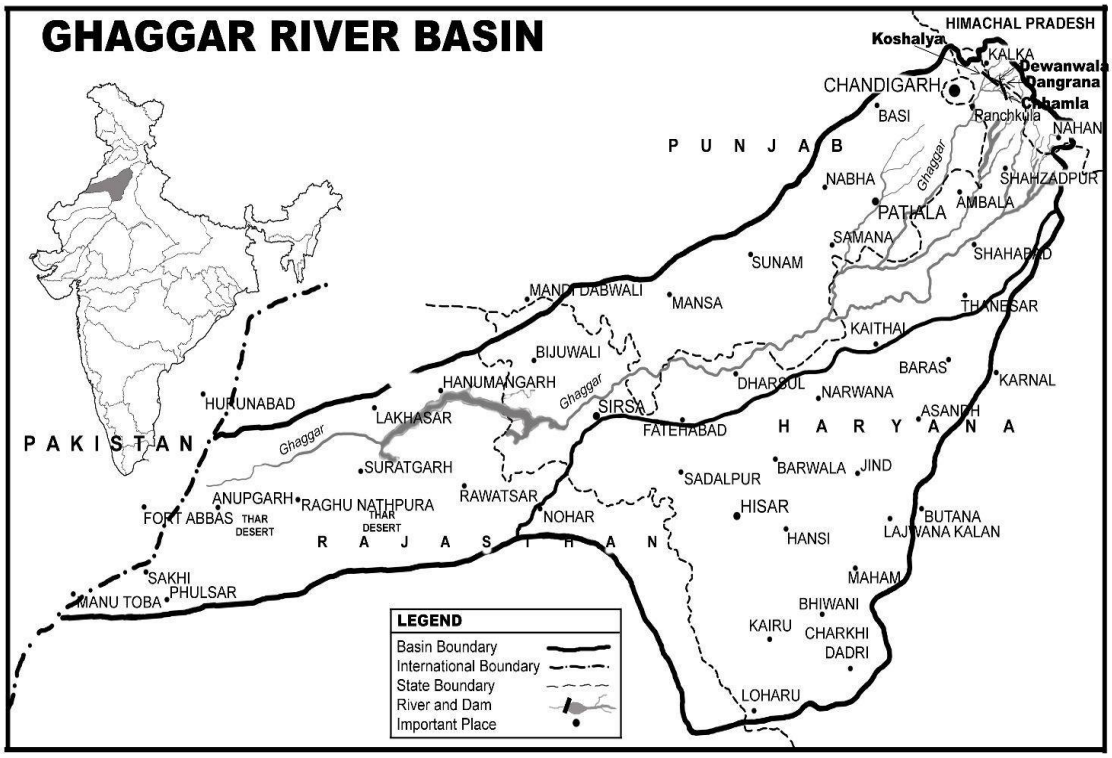
Sl. No	Trade name	Chemical concentration	Active ingredient	Recmdn.	Against
1	Adhar	Azospirillum		500g +500ml water + Ragi ganji/ kg seed or 2-3 Kg + 20Kg FYM/acre	
2	Azab	Azotobacter			
3	Biocatch	verticillium lecani		2g/lit	Aphids, Scales, Thrips, mealy bugs and nematode
4	Cal-MB	Organic based product		1-2ml/ltr	Sucking pests, leaf minor
5	Cal-Nova	Organic based product		2 ml/lit	
6	Cal-Paste	Organic based product		2ml/lit	
7	Caltika	Amino acids, Vit B1, B2, B6 & Folic acid		5ml/ltr	Growth promoter
8	Delfin	Bt var Kurstaki		0.5g/lit	DBM : Cabbage & Cauliflower
9	Humicil	Humic acid 6%	6%	5-10ml/ Kg seeds	Humic acid @ 1.5% for nursery sprays @ 1g/ltr
10	Lipel	Bacillus thuringiensis		0.50%	Bollworm, borer, leaf roller
11	Meta	Metarhizium			
12	Neem top	Neemseed extract		5 ml/l	Sucking pests
13	Rhizobium/ Sunrise	Rhizobium			

14	Shakti	Potassium bacteria			
15	Trishul	VAM			
16	Trichoderma/ Nisarga/ Bio-cure-F/ Rakshak-V	T. viridae 1%	1%	4g/kg	Seed treatment for rot, wilt, damping off
17	Varsha	Verticillium			

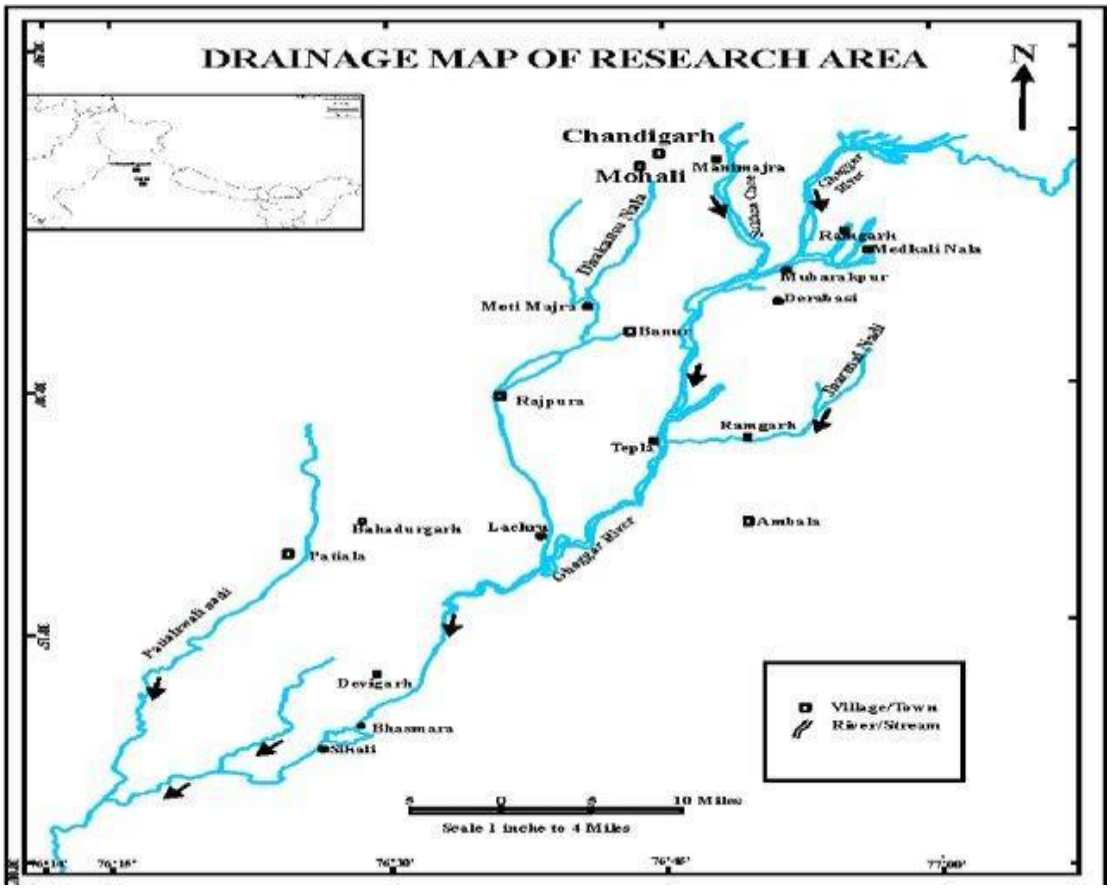
LIST OF HERBICIDE

Sl..N	Trade name	Chemical concentration	Active ingredient	Recmdn.	Against
1	Gramoxone	Paraquat dichloride	24% SL	2.5-4ml/l	Weeds
2	Oxy gold	Oxyfluorfen	23.5% EC	2 ml/lit	Weeds
3	Round -up	Glyphosate	41% SL	2ml/l	Weeds
4	Stomp	Pendimethalin	30% EC	2ml/l	Weeds

APPENDIX- I


GHAGGAR RIVER BASIN
HIMACHAL PRADESH
Koshalya
KALKA
Dewanwala
Dangrana
Chamla
CHANDIGARH
BASI
Ranchkula
NAHAN
P U N J A B
Ghaggar
NABHA
SHAHZADPUR
PATIALA
AMBALA
SAMANA
SHAHABAD
SUNAM
MANDI DABWALI
MANSA
THANESAR
KAITHAL
BIJUWALI
BARAS
KARNAL
HANUMANGARH
DHARSUL
NARWANA
HURUNABAD
LAKHASAR
SIRSA
ASANDH
FATEHABAD
H A R Y A N A
PAKISTAN
SURATGARH
SADALPUR
BARWALA
JIND
ANUPGARH
RAGHU NATHPURA
RAWATSAR
HISAR
FORT ABBAS
THAR DESERT
NOHAR
BUTANA
HANSI
LAJWANA KALAN
R A J A S T H A N
SAKHI
MAHAM
MANU TOBA
PHULSAR
BHIWANI
KAIRU
CHARKHI DADRI
LOHARU
LEGEND
Basin Boundary
International Boundary
State Boundary
River and Dam
Important Place

APPENDIX- II


DRAINAGE MAP OF RESEARCH AREA
N
Chandigarh
Mohali
Manimajra
Dhakana Nala
Sukhna Choe
Chandigar River
Ramgarh
Medkali Nala
Mubarakpur
Derabasi
Moti Majra
Banur
Rajpura
Sharnak Nala
Ramgarh
Tepla
Bahadurgarh
Lachra
Ambala
Patiala
Chaugar River
Patialewali nali
Devigarh
Bhasmara
Sirhali
Village/Town
River/Stream
10 Miles
Scale 1 inche to 4 Miles

Appendix -III

Pesticide spraying in fields.